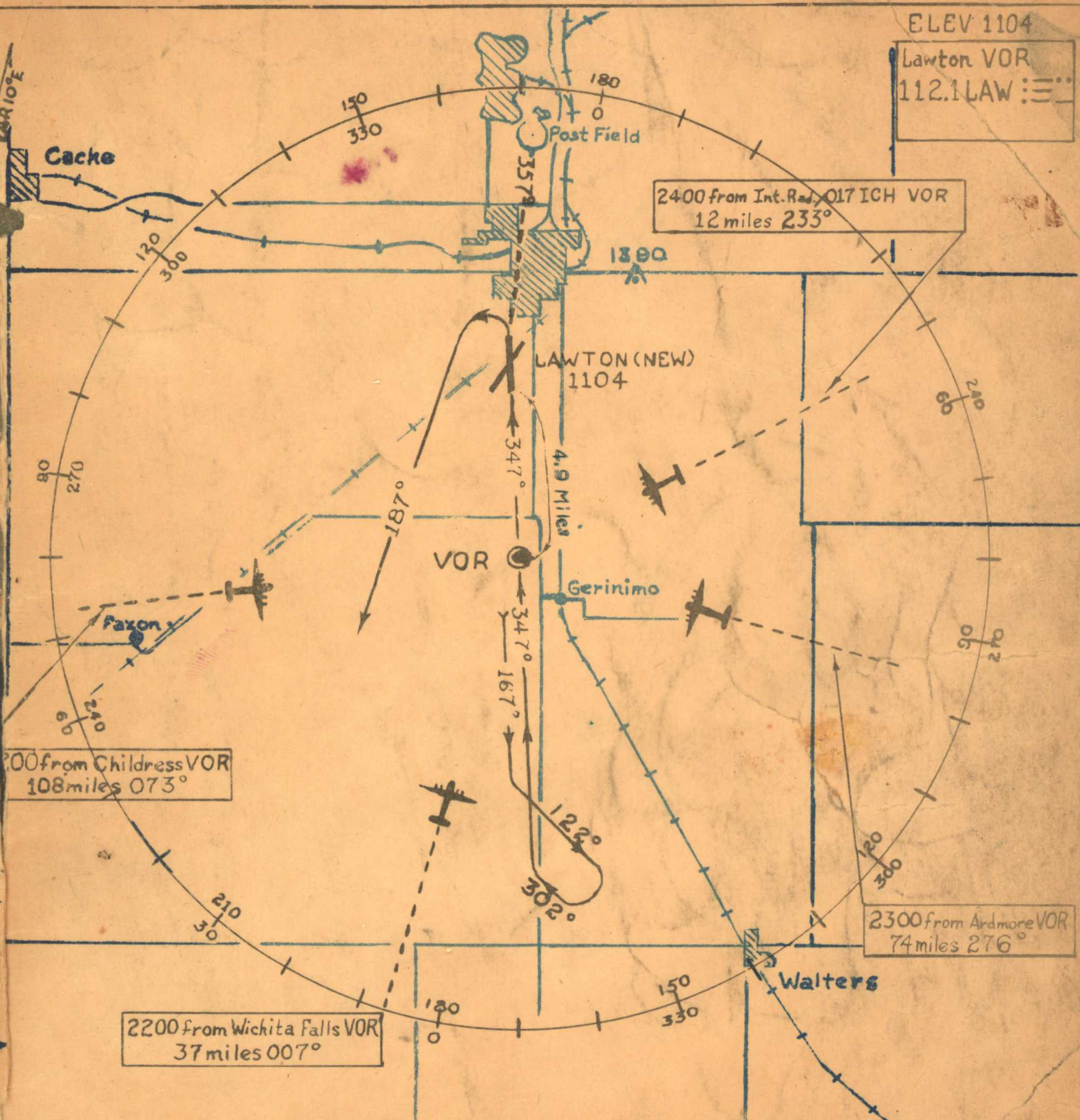
OVERHAUL INSTRUCTIONS AN-T-18

853-4534

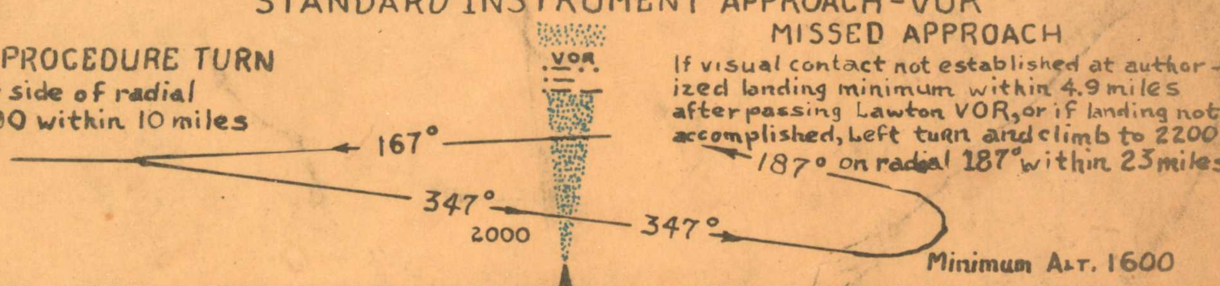
LAWTON-VOR



STANDARD INSTRUMENT APPROACH-VOR

PROCEDURE TURN
East side of radial
2500 within 10 miles

MISSED APPROACH
If visual contact not established at authorized landing minimum within 4.9 miles after passing Lawton VOR, or if landing not accomplished, Left turn and climb to 2200 on radial 187° within 23 miles



Statute Miles — ELEV 1104 — Nautical Miles

CEILING AND VISIBILITY MIN.			TIME IN MINUTES AND SECONDS TO AERODROME-DISTANCE 4.9 STAT. 4.25 NAUT. MILES									
TAKEOFF	DAY	NIGHT	M.P.H.	100	120	140	160	KNOTS	90	100	110	120
LANDING	DAY	NIGHT		2:56	2:27	2:06	1:50		2:50	2:33	2:19	2:07

08-25

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AN 28-5A-2

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Capt USAF

OVERHAUL INSTRUCTIONS

FOR

INSTRUMENT FLYING TRAINER

TYPE AN-2550-1

Published under joint authority of the Commanding General, Army Air Forces, the Chief of the Bureau of Aeronautics, and the Air Council of the United Kingdom.

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General.

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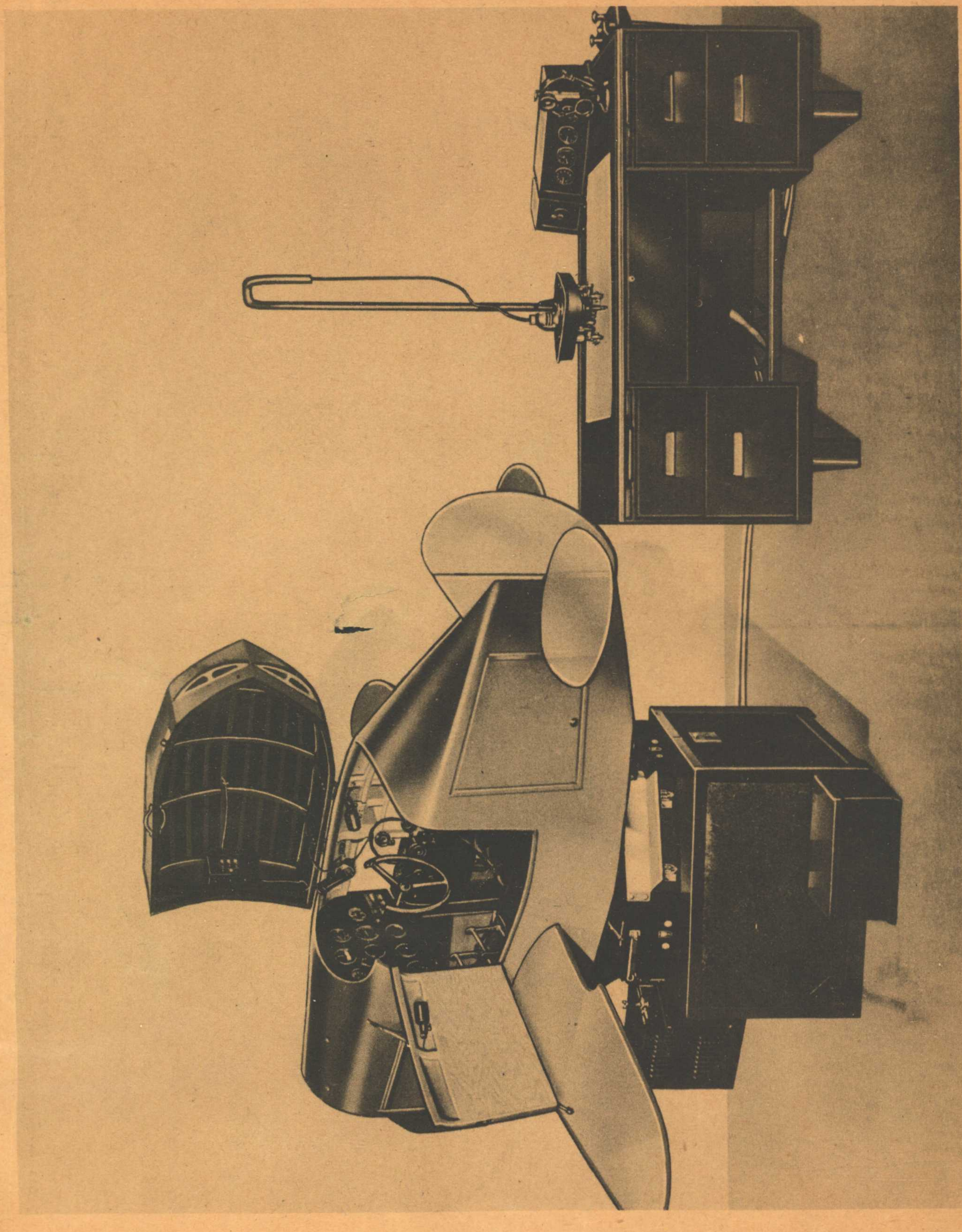


Figure 1—Instrument Flying Trainer AN-2550-1

SECTION I
INTRODUCTION

1. This Publication is the Handbook of Overhaul Instructions for Instrument Flying Trainer, AN-2550-1, manufactured by Link Aviation Devices, Inc., Binghamton, New York.

2. It contains a general and detailed description of the equipment involved, together with instructions for its operation, disassembly, inspection, repair, reassembly, and test.

3. In order to obtain maximum operating efficiency, the trainer should be maintained in first-class condition at all times. This can best be accomplished by adhering rigidly to a system of periodic inspection, lubrication, and maintenance. This will not only add years of satisfactory operation to the life of the trainer but will also, in many instances, eliminate the expense and delay entailed by a complete trainer overhaul.

4. Overhaul of the trainer consists of complete disassembly down to the main spindle; cleaning, inspection, testing; repair or replacement of worn or broken parts, and reassembly. As operating conditions vary in different localities and as some trainers may be subjected to a more thorough system of periodic maintenance than others, the need for a complete trainer overhaul can best be determined by the actual condition of the trainer rather than by the number of hours flown.

5. Difficulty in obtaining and maintaining instrument tolerances; rough, erratic, or faltering operation of trainer controls; and lost motion in linkages and link rods are specific conditions indicating the need of a complete trainer overhaul.

6. In order to avoid possible damage to sensitive trainer mechanisms, many of which require critical adjustment, it is important that the trainer be overhauled *only by trained personnel*.

7. Reference is made to the following publications which contain applicable data:

Publication No.	Title
AN 08-25-15	Handbook of Instructions—Instrument Flying Trainer, AN-2550-1 (Link)
AN 08-25-16	Parts Catalog — Instrument Flying Trainer, AN-2550-1 (Link)
AN 08-25A-1	Handbook of Link Trainer Instruments with Parts Catalog (Kollsman)
AN 08-25A-7	Handbook of Instructions with Parts Catalog—Turn and Bank Indicators, Type 1705-2T-A2, 1705-2AA-A2, and 1705-2AA-B2 (Pioneer)
AN 28-5-1 9	Handbook of Instructions with Parts Catalog — Autosyn Instrument, Type 2300-2-A (Pioneer)
AN 28-5-4	Handbook of Instructions with Parts Catalog—Artificial Horizon Indicator (Link)
AN 28-5-5	Handbook of Instructions with Parts Catalog—Standard Beam Approach Indicator (Flight Path) Type No. 1 (Link)
AN 28-5-16	Handbook of Instructions with Parts Catalog — Model 635, Types 11, 56P, and 57P Cross Pointer Indicators (Weston)
AN 28-5A-1	Handbook of Instructions with Parts Catalog for the Simulated Directional Gyro (Link)
T.O. No. 05-1-9	Handbook of Instructions with Parts Catalog—Aircraft Clocks (Jaeger)
T.O. No. 05-1-13	Handbook of Overhaul Instructions—Voltmeters, Ammeters, and Volt-Ammeters
T.O. No. 05-15-2	Handbook of Service and Overhaul Instructions for Magnetic Type Compasses
T.O. No. 05-20-7	Handbook of Instructions with Parts Catalog—Link Trainer Turn and Bank Indicator Type 1716-2N-A2 (Pioneer)
T.O. No. 00-35A-3	Procedure for Disposing of Damaged or Condemned Air Forces Property
T.O. No. 05-1-1	Inspection, Maintenance, Storage, and Shipment of Instruments and Instrument Maintenance Parts

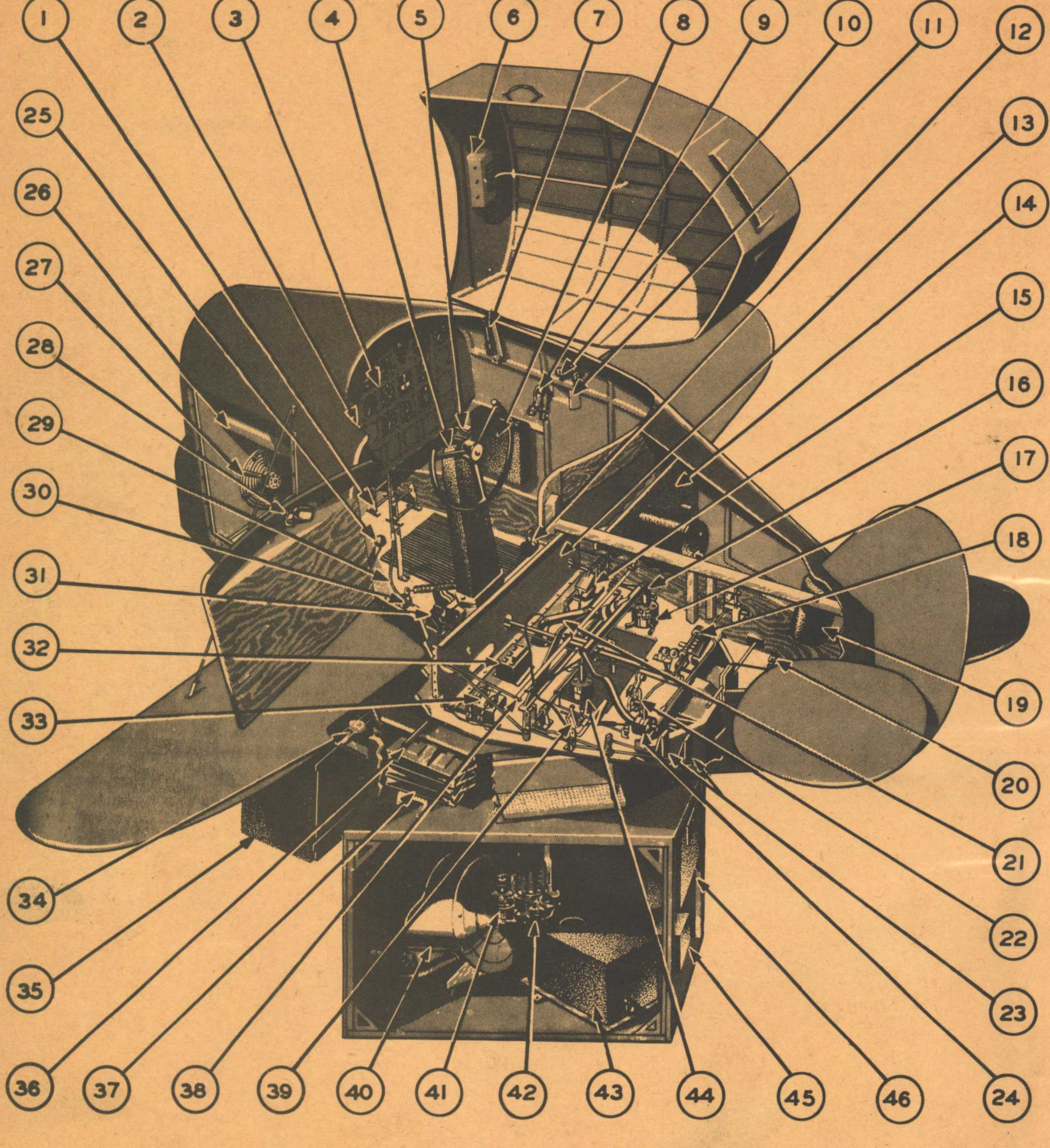


Figure 2—Trainer Fuselage Interior with Octagon and Base
(See reference list on opposite page)

SECTION II
DESCRIPTION

1. GENERAL.

a. The Link instrument flying trainer is ground equipment used for teaching both elementary and advanced instrument flying, radio navigation, radio range orientation, and instrument landing and take-off procedures.

b. Instrument flying is the process of piloting an airplane on a predetermined course when conditions are such that the pilot has no visual contact with the earth or heavenly bodies. This type of flying is dependent entirely upon correct interpretation of instrument indications to maintain normal flight positions, together with proper knowledge and use of visual and aural radio indications for determining and maintaining proper direction. Proper knowledge and correct interpretation of instrument and radio indications are also essential in instrument landing and take-off procedures.

c. For the purpose of explanation, the trainer may be divided into four sections, namely, base, revolving octagon, fuselage, and operator's desk. (See figure 3.) The base, revolving octagon, and fuselage are assembled as one unit and commonly referred to as the "trainer." The operator's desk is a self-contained unit and is connected electrically and by flexible shafts to the trainer.

d. The fuselage is equipped with instruments and controls necessary to simulate an airplane on instrument flight. (See figure 2.) It is mounted on a universal joint which permits bank and pitch movements in excess of maneuvers required of an airplane during instrument flight. The universal joint is mounted on a turntable, known as the revolving octagon. The revolving octagon (figure 5) houses the four main bellows and is connected to a spindle mounted in the main bearing housing, the bearing housing being bolted to an iron cross attached to the square base of the trainer. This arrangement permits rotation of the fuselage, revolving octagon, and spindle in either direction while the square base of the trainer remains fixed.

e. In addition to serving as a support for the fuselage, revolving octagon, and spindle, the square base houses the vacuum turbine, the wind drift mechanism, the base terminal box, and the telegon oscillator.

Reference List. (See figure 2.)

1. *Rudder Pedal*
2. *Fluorescent Panel Light*
3. *Pilot's Instrument Panel*
4. *Control Column and Wheel*
5. *Turn Indicator Regulator Bellows*
6. *Flap Control, Landing Gear, and Propeller Pitch Control Panel*
7. *Fluorescent Panel Light*
8. *Fuselage Control Box*
9. *Microphone and Radio Head Set*
10. *Moonbeam Spotlight*
11. *Operator's Peephole*
12. *Simulator, Rudder*
13. *Baffle Plate*
14. *Remote Instrument Transmitter Panel*
15. *Spin Trip Bellows and Assembly*
16. *Main Air Transfer Manifold*
17. *Rudder Valve*
18. *Rough Air Generator*
19. *Air-Speed Damping Tank*
20. *Icing Valve Signal Lamp*
21. *Conductor Elbow*
22. *Spin Valve*
23. *Air-Speed and Manifold Pressure Regulator Bellows*
24. *Aileron Valve*
25. *Throttle*
26. *Climb-Dive Tank*
27. *Ventilating Fan*
28. *Moonbeam Spotlight*
29. *Simulated Gyro Flexible Shaft*
30. *Simulator, Elevator*
31. *Simulator, Aileron*
32. *Interconnector Box*
33. *Climb-Dive Valve*
34. *Belt Tightener*
35. *Turning Motor*
36. *Fuselage Stop*
37. *Banking Bellows, Left*
38. *Rudder Bar*
39. *Stall Valve*
40. *Vacuum Turbine*
41. *Automatic Radio Compass Take-Off*
42. *Collector Rings and Brushes*
43. *Wind Drift Mechanism*
44. *Elevator Valve*
45. *Telegon Oscillator*
46. *Base Junction Box*

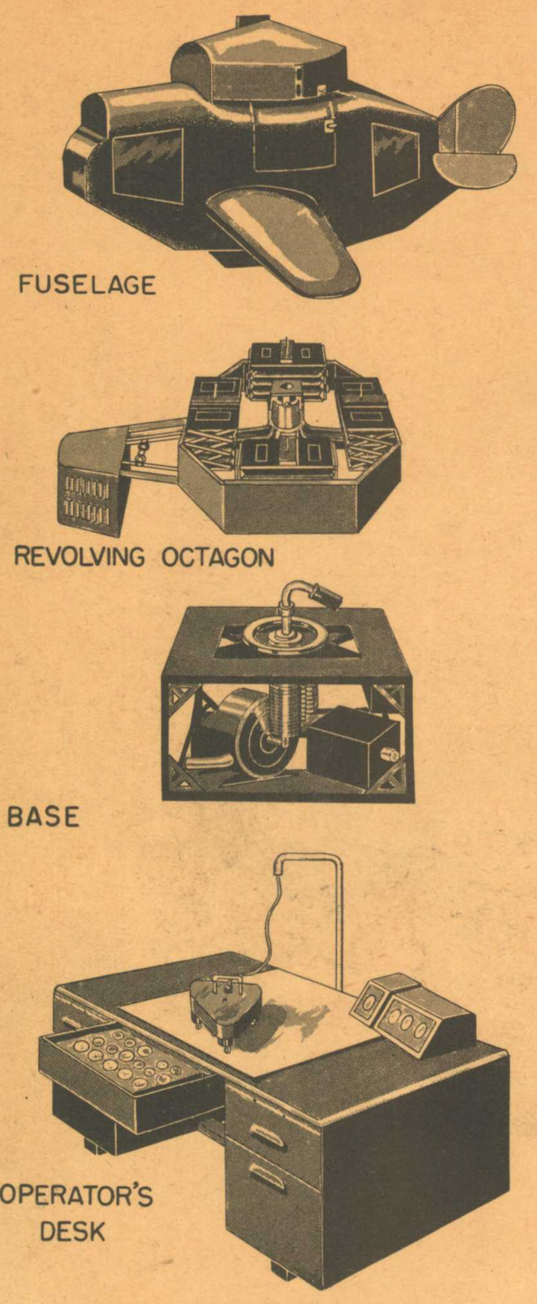


Figure 3—Main Trainer Assemblies

f. The operator's desk houses the electrical equipment for reproducing the aural and visual radio signals encountered in actual flight, interphone equipment, and wind direction and wind speed controls for the wind drift mechanism. (See figure 9.) An automatic recorder, located on the operator's desk, traces the path of simulated flight on a map or chart. The operator's desk is also equipped with duplicate altimeter, air-speed, and vertical-speed indicators, together with an automatic radio compass control.

2. DETAILED.

a. BASE. (*See figures* 4 *and* 5.)

(1) The square base of the trainer houses the vacuum turbine, which provides vacuum for the operation of the banking and pitching bellows, the turning motor, and all vacuum operated assemblies and instruments. The turbine has a four-stage (four impellers) centrifugal type blower having a capacity of approximately 12 cubic feet per minute at 4-3/8 in. Hg. Power for operation of the turbine is supplied by a 3/4 hp universal type motor, the turbine and motor being contained in one unit. (See figure 7.)

(2) The main bearing housing is mounted in the center of the top of the base and contains two bearings in which the spindle revolves. Mounted on the bottom of the bearing housing is a brush assembly, by means of which electrical current is transferred to the collector rings attached to the bottom of the main spindle.

(3) The spindle itself serves as a conduit for electric wiring between the collector rings and the terminals in the fuselage. A tube inside the spindle connects the vacuum turbine in the base with the vacuum manifold in the fuselage.

(4) The base terminal box is the main power distribution point, and electrically connects the base, fuselage, and desk.

(5) The wind drift mechanism (figure 48), located in the base of the trainer, is geared to the spindle and electrically connected to the automatic recorder on the operator's desk. It introduces the effect of various wind directions and speeds on trainer heading as traced by the automatic recorder. The mechanism consists of an assembly of gear trains so arranged that when the various elements of the wind drift problem are led into it, the output is track and ground speed. By turning the wind direction and wind velocity cranks, located on the right-hand side of the operator's desk, the operator, either before or during a problem, can apply wind speed from zero up to 60 mph and wind direction from zero through 360 degrees to trainer heading and air speed.

(6) The telegon oscillator, located in the base of the trainer, supplies 700-cycle current for the remote indicating instruments. Power supply to the unit should be 110 to 115 volts, 50- to 60-cycle frequency. The output of the unit should be 80 to 90 volts, 700 cycles, plus or minus 35 cycles per sec-

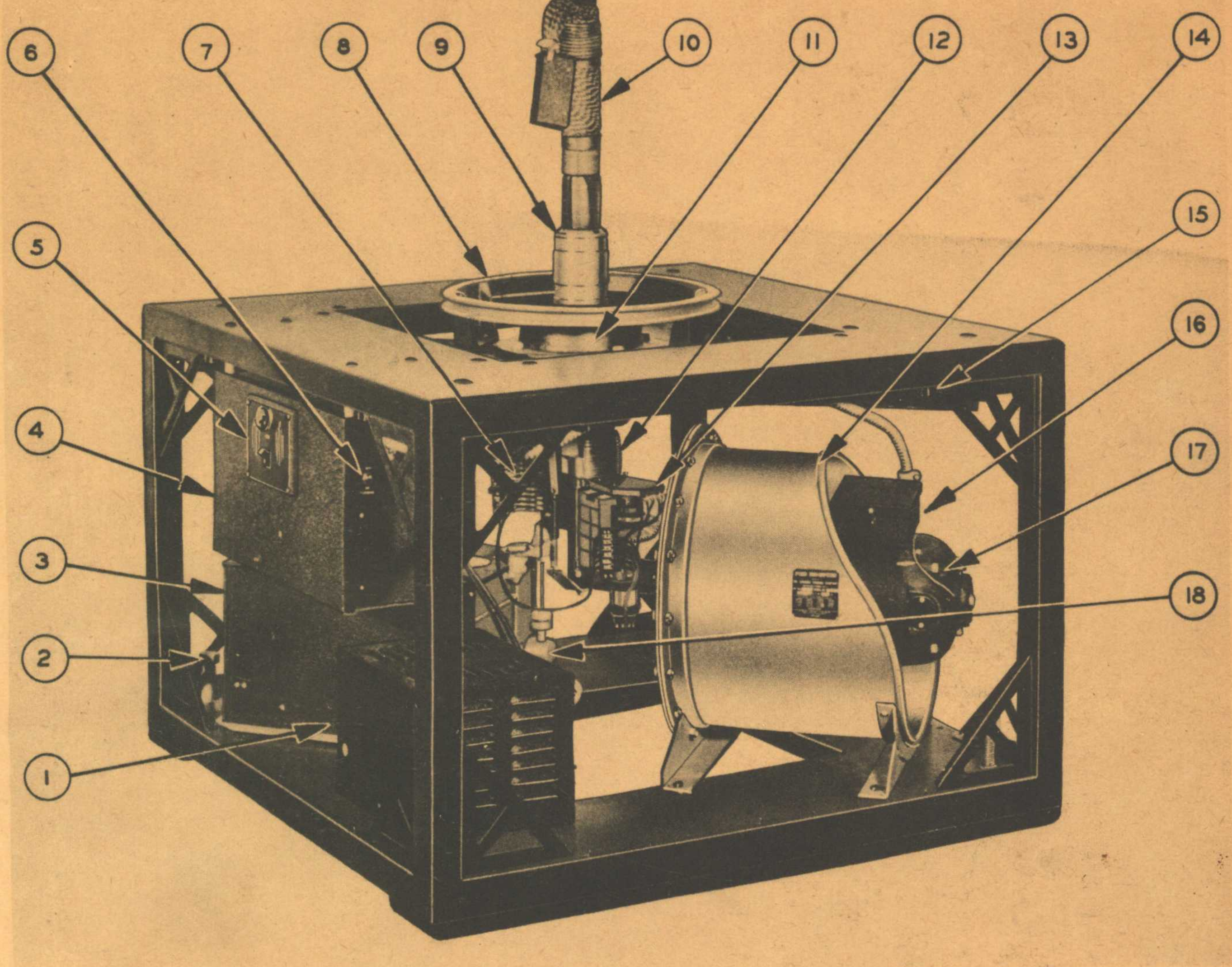


Figure 4—Trainer Base

1. *Telegon Oscillator*
2. *Leveling Screw*
3. *Wind Drift Mechanism*
4. *Base Junction Box*
5. *Line Switch*
6. *Turbine Switch*
7. *Collector Ring Brushes*
8. *Sheave*
9. *Main Spindle*
10. *Spindle Wiring*
11. *Simulated Directional Gyro Take-Off Gear*
12. *Collector Rings*
13. *Automatic Radio Compass Teletorque Unit*
14. *Vacuum Turbine*
15. *Base Panel Retaining Clips*
16. *Turbine Filter Box*
17. *Turbine Motor*
18. *Wind Drift Drive*

ond. It utilizes a type 83V rectifier tube and three 6L6G tubes, one as an oscillator and the other two as amplifiers to increase the voltage to the necessary level for proper operation of the instruments.

(7) The automatic radio compass take-off unit, mounted on the bearing housing (figure 5), is geared to the main spindle and, by means of two teletorque motors and a differential, transmits the factor of trainer heading to the automatic radio compass indicator on the trainer instrument panel.

(8) The simulated gyro take-off consists of a fixed arm, mounted on the spindle above the bearing housing, to which is attached a floating arm containing a splined shaft with an 18-tooth pinion on the lower end. This pinion is engaged by spring tension to a ring gear mounted on the bearing hous-

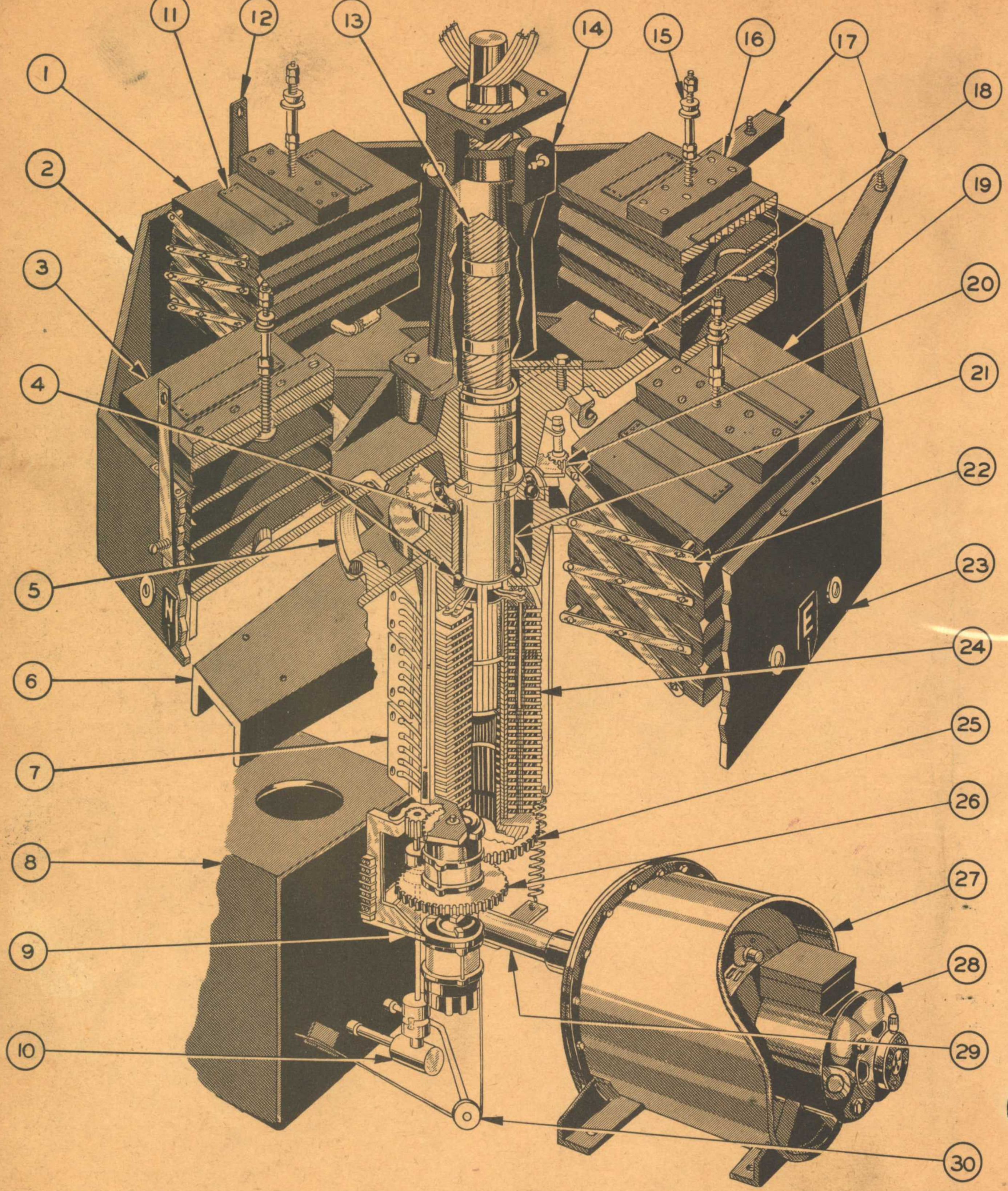


Figure 5—Revolving Octagon Containing Main Bellows and Spindle, with Turbine and Wind Drift
(See reference list on opposite page)

ing in the trainer base. When the trainer turns, the drive take-off assembly rotates around the ring gear, imparting motion to the pinion which, by means of a flexible shaft, moves the dial on the simulated gyro indicator on the instrument panel. A flat rod connected to the floating arm on the drive take-off assembly extends from the front of the revolving octagon. Pulling outward on this rod disengages the pinion from the ring gear, making the indicator on the instrument panel inoperative. (See figure 80.)

Note

For further information regarding the Simulated Directional Gyro, refer to AN 28-5A-1, Handbook of Instructions with Parts Catalog for the Simulated Directional Gyro.

(9) Four removable panels fit into the four sides of the base and are held in place by spring clips and studs.

Note

At locations where there is considerable fluctuation in line voltage, or where only 200–260 volt current is available, the constant voltage transformer (figure 61) may be installed. The constant voltage transformer maintains a constant voltage regardless of line fluctuation. If used, it should be mounted on the wall of the trainer room under the cut-off switch or on the floor near the conduit containing the trainer power supply leads. Installation should be made in accordance with the instructions contained on the transformer name plate. As the use of the constant voltage transformer adds materially to the current used, because of the low power factor inherent in a device of this type, its use is not recommended at locations where the line voltage remains fairly constant (between 110 and 120 volts).

b. REVOLVING OCTAGON. (*See figure* 5.)

(1) The revolving octagon is an eight-sided frame, seven inches deep, housing the four main bellows. Two of these are banking bellows, located on the right and left, and two are pitching bellows, located in the front and rear. All are identical in operation and are interchangeable.

(2) Each bellows is attached at the bottom to an iron cross in the base of the octagon, known as the octagon cross, and at the top to the floor of the fuselage.

(3) Each bellows is constructed with a wood top and base and two wood partitions, encased with rubberized fabric. Each bellows is equipped with two escape valves, consisting of several holes drilled through the top and covered by a rubberized fabric flap. These flaps are stretched tightly over the holes and tacked at the ends. When the bellows are collapsed by movement of the fuselage these flaps act as safety valves, permitting air to escape quickly without damage to the bellows, but when vacuum is being applied to the inside of the bellows, the flaps form an air-tight seal.

(4) Bellows toggles are connected to the ends of each bellows to insure that the bellows expand and contract (collapse) squarely.

(5) The universal joint is secured to the revolving octagon directly over its center by four stud bolts. It consists of a pedestal support with two bearing arms and a top mounting plate for the

Reference List. (See figure 5.)

1. Left Banking Bellows
2. Octagon
3. Rear Pitching Bellows
4. Main Bearings
5. Sheave
6. Octagon Cross
7. Collector Ring Brushes
8. Wind Drift
9. Automatic Radio Compass Take-Off Unit
10. Right Angle Wind Drift Drive
11. Bellows Flap Valve
12. Locking Straps
13. Spindle Wiring
14. Universal Joint
15. Bellows Studs
16. Front Pitching Bellows
17. Turning Motor Supports
18. Bellows Hose Elbows
19. Right Banking Bellows
20. Simulated Gyro Take-Off Gear
21. Main Spindle
22. Bellows Toggles
23. Compass Card
24. Collector Rings
25. Autosyn Pick-Up Gear
26. Base Teletorque Gear
27. Vacuum Turbine
28. Turbine Motor
29. Transfer Elbow
30. Air-Speed Cable and Pulley

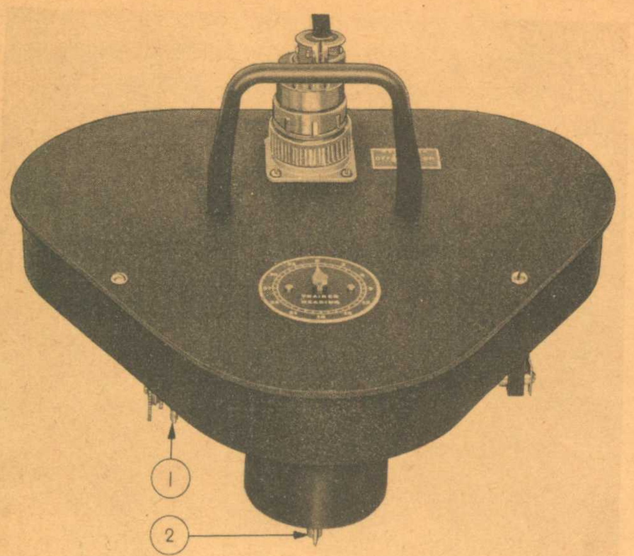


Figure 6—Automatic Recorder

1. Drive Wheel *2. Inking Wheel*

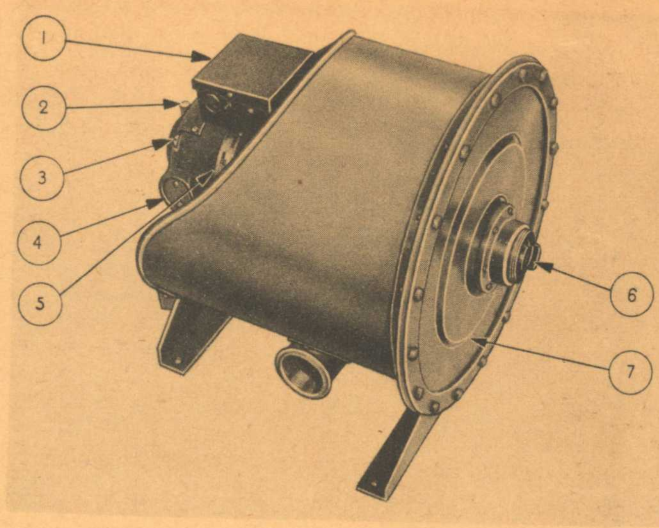


Figure 7—Vacuum Turbine

1. Motor Filter Box	*5. Turbine Motor*
2. Grease Cup	*6. Turbine Exhaust*
3. End Bell	*7. Turbine Intake*
4. Brush Holder	*8. End Head*

fuselage. The mounting plate is connected to the pedestal by means of a gimbal ring and bearings, permitting pitch and bank movements of the fuselage in excess of maneuvers required of an airplane during instrument flight.

(6) The turning motor is hung beneath angle iron brackets attached to the octagon cross and extends outward from the octagon under the front of the fuselage. The motor is vacuum operated and consists of two banks of five double-action bellows, each bank being connected to a crankshaft by connecting rods. The crankshafts of both banks of the motor are geared to the same reduction gear unit, terminating on a pulley for a round leather belt. This belt goes around a fixed sheave mounted on the top of the base, so that the turning motor pulls itself, with the octagon and fuselage, around the base. Each bank of the turning motor is connected by a separate vacuum line to the rudder valve in such a manner that when right rudder is applied, vacuum is caused to operate on the right bank of the turning motor, causing the trainer to turn to the right. Application of left rudder causes vacuum to be applied to the left bank, causing the trainer to turn to the left. Due to the construction of the rudder valve, when vacuum is being applied to one bank of the turning motor, the other bank is vented to atmosphere, so that when one bank is operating the other bank is idling.

(7) Two metal locking straps are mounted on the revolving octagon, one on the left side and one on the rear. These locking straps, when engaged with the fuselage, prevent banking and pitching movements. They are used when the trainer is not in use, when a student is entering or leaving the trainer, and also when making adjustments or repairs within the fuselage.

c. FUSELAGE. (*See figure* 2.)—The fuselage is made of plywood and resembles the fuselage of a small single-seater airplane. It is equipped with a hood for instrument flying and, in addition to rudder, aileron, and elevator controls for the pilot, contains the following instruments and mechanisms:

(1) INSTRUMENT PANEL. (*See figure* 8.)—The instrument panel is equipped with the following instruments and switches:

(*a*) AIR-SPEED INDICATOR. (*See figure* 32.)—This indicator is a vacuum operated instrument and measures the vacuum applied to the diaphragm of its transmitter through an air-speed regulator bellows and, by means of three telegon motors, indicates these measurements in terms of air speed in miles per hour on the dial of the indicator on the trainer instrument panel, and on the dial of the indicator on the operator's desk.

(*b*) ALTIMETER. (*See figure* 33.)—The altimeter is a pressure indicating instrument and is operated by pressure changes in the altitude system caused by throttle setting and trainer attitude. By means of its three telegon motors these measure-

ments are transmitted in terms of hundreds of feet of altitude to the dial of the indicator on the instrument panel and to the dial of the indicator on the operator's desk. It differs from an actual aircraft instrument in that it has a gear ratio of 2 to 1.

(*c*) VERTICAL-SPEED INDICATOR. (*See figure* 34.)—This instrument is similar in operation to the altimeter, except that it measures the rate of change of pressure in the altitude system, indicating these measurements on the dials of the indicator in the cockpit and on the operator's desk in terms of rate of gain or loss of altitude in feet per minute.

(*d*) TURN AND BANK INDICATOR. (*See figure* 37.)—This instrument is gyro-operated and is similar to a standard aircraft instrument except that, due to lack of centrifugal force in the trainer, the inclinometer (ball bank indicator) is mounted on a pivot and linked to the gimbal ring of the gyro. It is used in maintaining straight and level flight, making precision turns at predetermined rates, and in properly coordinating rudder and aileron action when making turns.

(*e*) MAGNETIC COMPASS. (*See figure* 38.)—The magnetic compass is a standard aircraft instrument and is subject to magnetic influences as in an airplane, except that, due to the lack of centrifugal force in the trainer, northerly turning error does not occur. Northerly turning error is reproduced in the trainer by means of a compass deflector (figure 39), consisting of a small electro-magnet mounted under the magnetic compass and two electrical contacts on the rudder valve.

(*f*) DIRECTIONAL GYRO. (*See figure* 40.)—This is a standard aircraft instrument. It is vacuum operated in the trainer as in an airplane. It is not affected by magnetic influences and is used to supplement the magnetic compass for maintaining course, to indicate magnitude or amount of turn, to aid in compensating the magnetic compass, and to maintain alignment when making instrument landings and low approaches.

(*g*) ARTIFICIAL HORIZON. (*See figure* 41.)—This instrument is a simulated artificial horizon and is operated by pendulums instead of by a gyroscope. It provides indications in the trainer identical with indications obtained from the gyro-operated artificial horizon. (Refer to AN 28-5-4, Handbook of Instructions with Parts Catalog—Artificial Horizon Indicator.)

(*h*) MANIFOLD PRESSURE INDICATOR. (*See figure* 35.)—This instrument reproduces manifold pressure indications as a result of changes in vacuum applied to the diaphragm of the instrument. The diaphragm of the instrument is connected by tubing to a spring-controlled regulator bellows which is linked mechanically to the throttle lever and to the pitch action compensator rod in such a manner that changes in throttle position and/or changes in fore and aft attitude of the trainer cause proportionate changes in manifold pressure indications on the dial of the instrument.

Note

Instrument flying trainers prior to Link Serial No. 8454 were equipped with a tachometer instead of a manifold pressure indicator. The operation of the tachometer used on these earlier trainers is identical with the manifold pressure indicator except that it reproduces indications of engine speed in terms of rpm.

(*i*) FUEL GAGE AND SWITCHES. (*See figure* 42.)

1. The fuel gage consists of a clockwork mechanism with a single pointer and dial registering up to 50 gallons. When fully wound it requires approximately one hour to run down. The fuel gage is made operative by the fuel gage switch.

2. The trainer ignition switch, located on the instrument panel, controls the operation of the turbine, in the event the turbine switch in the base junction box has been turned on. The ignition switch also controls the ventilating fan, the rough air generator motor, the vibrator motors, and the instrument panel and cockpit lights. The ignition switch is automatically shut off when the fuel gage registers zero, unless the fuel gage switch has been closed.

3. The pitot tube heater switch is also located on the instrument panel.

(*j*) AUTOMATIC RADIO COMPASS.

1. The automatic radio compass provides the student in the trainer with a method of receiving simulated radio compass bearings.

2. These simulated bearings are transmitted to the radio compass dial on the trainer instrument panel by means of four teletorque motors, one connected to the manually operated vernier control

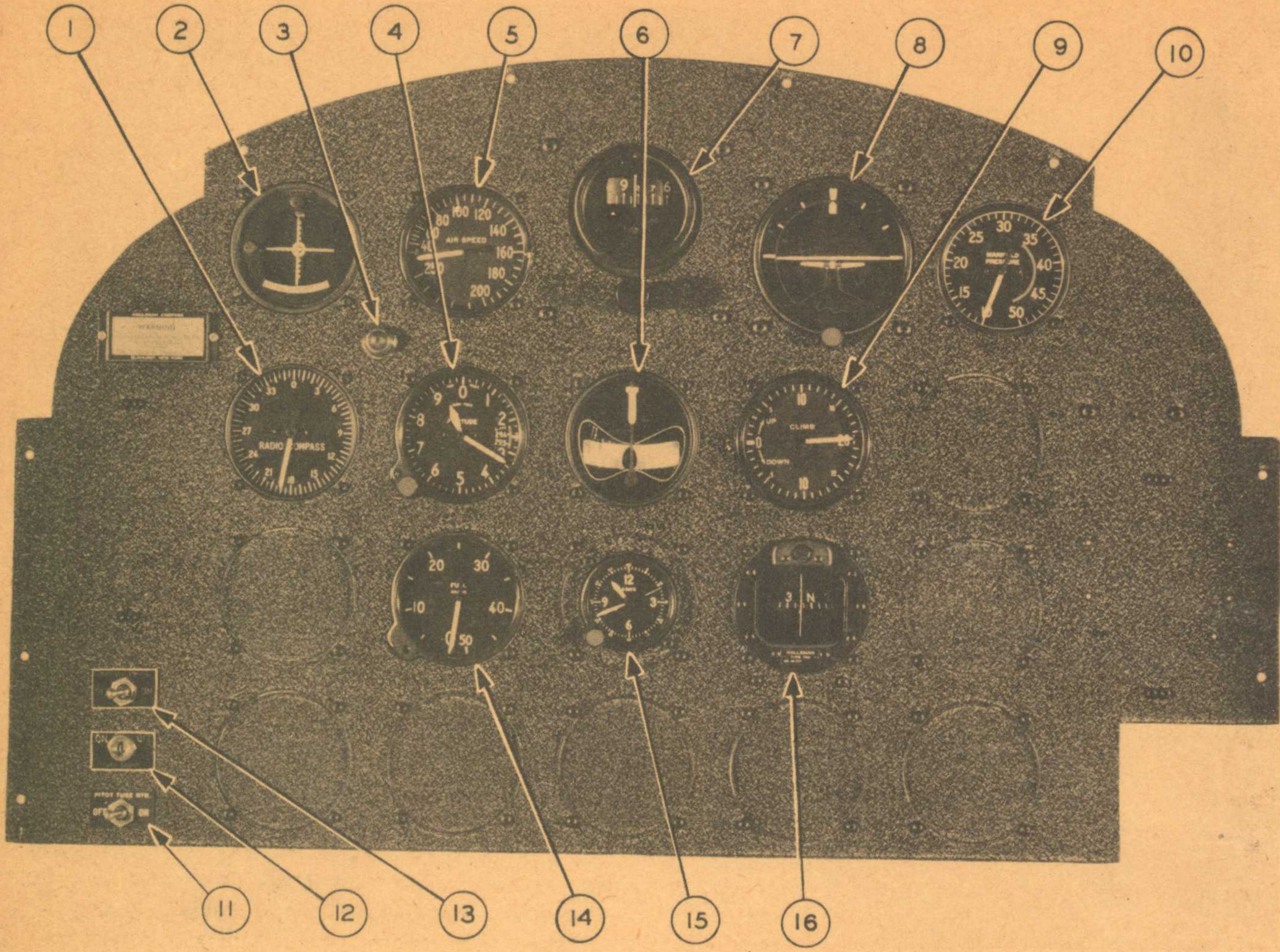


Figure 8—Pilot's Instrument Panel

1. *Automatic Radio Compass*
2. *Army Cross Pointer, Navy Cross Pointer, or Standard Beam Approach Indicator*
3. *Visual Marker Indicator*
4. *Altimeter*
5. *Air-Speed Indicator*
6. *Directional Gyro*
7. *Turn and Bank Indicator*
8. *Artificial Horizon*
9. *Vertical-Speed Indicator*
10. *Manifold Pressure Indicator*
11. *Pitot Tube Heater Switch*
12. *Fuel Gage Switch*
13. *Ignition Switch*
14. *Fuel Gage*
15. *Clock*
16. *Magnetic Compass*

on the operator's desk, two located in the base of the trainer, and the fourth connected to the radio compass indicator on the trainer instrument panel.

(*k*) VIBRATOR MOTORS. (*See figure* 104.)—Three vibrator motors, consisting of small constant-speed motors with two adjustable flywheels mounted in an eccentric position on the motor shaft, are used in the trainer to provide sufficient vibration for smooth instrument operation. One vibrator motor is located on the back of the main instrument panel, one on the remote instrument transmitter panel in the rear of the fuselage, and one on the remote instrument panel located on the operator's desk.

(2) INSTRUMENT AND COCKPIT LIGHTS.

(*a*) Two spotlights, each equipped with a 12-volt, 6-candlepower double contact bulb, are used for lighting the cockpit.

(*b*) Two fluorescent lamps, one mounted on each side of the fuselage, are used to activate the

luminous dials of the instruments on the cockpit instrument panel. Controls for both daylight and ultra-violet light are provided.

(3) FLAP CONTROL, LANDING GEAR, AND PROPELLER PITCH CONTROL DEVICE. (*See figure* 43.)

(*a*) The purpose of this device is to accustom the student in the trainer to performing the routine operations of raising or lowering flaps and wheels and setting propeller pitch.

(*b*) Through the use of this device, visual indications are available to both the student and the operator as to the simulated flap and propeller pitch positions, while automatic visual and aural signals warn the student to lower the landing gear when coming in for a landing.

(4) REMOTE INSTRUMENT TRANSMITTER PANEL. (*See figure* 65.)—The remote instrument transmitter panel is located behind the pilot's seat in the rear of the fuselage. On this panel are mounted the transmitters for remote indication of air speed, altitude, and rate of climb, as registered by the air-speed indicator, altimeter, and vertical-speed indicator on both the cockpit instrument panel and on the remote instrument panel located on the operator's desk. Each unit of this system of remote indication consists of a telegon transmitting motor located on the transmitter panel connected with duplicate telegon receiving motors which actuate the pointers of the instruments in the fuselage and the instruments on the desk. One of the vibrator motors is also installed on the remote instrument transmitter panel.

(5) FUSELAGE CONTROL BOX. (*See figure* 64.)

(*a*) The fuselage control box is mounted on the right-hand side of the trainer cockpit and serves as a distribution point for current required for operation of electrical equipment on the instrument panel.

(*b*) It also contains headphone and microphone jacks, together with the necessary controls and switches for the radio and instrument landing systems.

(6) MAIN VALVES. (*See figures* 15, 16, *and* 17.)—Three main valves are used in the trainer, namely, aileron valve, elevator valve, and rudder valve. These valves are connected to the main vacuum supply, and through linkages, to the aileron, elevator, and rudder controls. Vacuum connections to the four main bellows and the turning motor produce banking, pitching, and turning motions of the fuselage.

(*a*) The aileron valve, in response to right or left movement of the wheel or stick, applies vacuum to the right or left banking bellows, causing the trainer to bank to the right or left. The tendency of an airplane to bank automatically when rudder is applied, is reproduced in the trainer by linkage between the center leaf of the aileron valve and the rudder action.

(*b*) The elevator valve, in response to fore and aft movement of the wheel or stick, applies vacuum to the front or rear pitching bellows, causing the trainer to nose down (dive) or nose up (climb).

(*c*) The rudder valve, in response to movement of the rudder pedals, applies vacuum to the right or left bank of the turning motor, causing the trainer to turn to the right or left. The tendency of an airplane to automatically nose down during a turn is reproduced mechanically in the trainer by means of special ports in the rudder valve which are connected to the front and rear pitching bellows. The tendency of an airplane to automatically turn in the direction of the low wing when banking is reproduced in the trainer by means of linkage between the rudder valve and the banking action through the bank turner assembly (figure 21).

(7) STALL VALVE. (*See figures* 23 *and* 89.)—When the air speed of an airplane drops below a certain minimum, the airplane stalls and sometimes starts to spin. This characteristic is reproduced in the trainer by means of the stall valve in conjunction with the spin trip assembly. The stall valve bellows is connected by tubing with the vacuum line leading from the air-speed regulator bellows to the air-speed indicator. As the air speed is decreased the pressure applied to the stall valve is also decreased until a point is reached where spring tension pulls open the stall valve bellows, applying vacuum to the spin trip bellows, causing it to collapse. As the spin trip assembly is linked to the rudder action, the collapsing of the spin trip bellows opens the rudder valve to its maximum position, causing the trainer to spin.

(8) SPIN VALVE. (*See figure* 25.)—The spin valve is a simple two-way valve actuated by an inverted pendulum, the movement of which depends upon the lateral attitude of the fuselage. Movement

of the pendulum determines whether the fuselage will spin to the right or to the left.

(9) CLIMB-DIVE VALVE. (*See figure* 28.)

(*a*) The climb-dive valve assembly, located on the floor of the fuselage, consists of two valves, both of which are connected to the vacuum line leading to the climb-dive tank and to the vacuum lines leading to the diaphragms of the altimeter and vertical-speed indicator transmitters.

(*b*) These valves are actuated through linkages by movement of the throttle, and by nose-up or nose-down movement of the trainer. They control the vacuum pressure within the altitude (climb-dive) tank and, hence, the indications on the altimeter and vertical-speed indicator.

(10) ROUGH AIR GENERATOR. (*See figure* 22.)

(*a*) The effect of air currents or rough weather on an airplane is reproduced in the trainer by means of the rough air generator located in the rear of the fuselage and operated by a small constant-speed electric motor.

(*b*) The bumps are simulated by means of cam-operated flap valves to which are connected vacuum lines leading to the banking and pitching bellows and to the two banks of the turning motor.

(*c*) The rough air generator is turned on or off by means of a crank located under the rear of the fuselage. This crank may be turned in partially, if desired, to reproduce varying degrees of rough air.

(11) SHUT-OFF VALVES AND DE-ICING EQUIPMENT. (*See figures* 44 *and* 77.)

(*a*) Icing of the pitot head and venturi tubes is simulated in the trainer by a shut-off valve in the vacuum line to the air-speed indicator. This valve is located beneath the rear of the trainer fuselage and may be opened or closed by the operator with or without the student's knowledge.

(*b*) The pitot tube heater switch on the trainer instrument panel simulates the pitot heater insofar as the student in the trainer is concerned. Actually, it operates a neon light located under the right rear longeron near the air-speed shut-off valve. The turning on of this light indicates to the operator that the student has observed the icing condition and has taken necessary remedial action.

(*c*) Plain shut-off type valves are also located in the vacuum lines leading to the vacuum operated directional gyro and turn and bank indicator, their purpose being to simulate freezing or defective operation of these instruments. The controls for these valves are located outside the fuselage on the right-hand side and when the trainer is in operation, are accessible only to the operator. When the valves are closed the directional gyro and turn and bank indicator become inoperative. The student must rely on the magnetic compass and radio signals for maintaining course, and on the artificial horizon for maintaining proper trainer attitude.

Note

On trainers equipped with the Link Simulated Directional Gyro, freezing or defective operation of the instrument is simulated by means of a shut-off rod extending from the front of the revolving octagon.

(12) INTERCHANGEABLE WHEEL AND STICK CONTROL. (*See figures* 12 *and* 13.)

(*a*) This unit provides a ready method of changing from wheel control to stick control or vice versa.

(*b*) Aileron and elevator control pressure is accomplished by means of spring action set in the base of the control column.

(*c*) The spring controlling the elevator pressure is adjustable.

(*d*) An additional pair of lighter springs are provided in the tool kit. Where it is desirable for the operator to simulate airplanes with a light "feel" on the aileron control, these lighter springs can be installed.

(13) THROTTLE CONTROL. — Movement of the throttle, located on the left side of the trainer cockpit, affects the readings of the air-speed indicator and the manifold pressure indicator, by means of linkages to the pitch action shaft and the air-speed and manifold pressure regulator bellows. Vacuum lines connect these bellows to the diaphragms of the indicating instruments.

(14) SLIP-STREAM SIMULATORS. (*See figure* 14.)

(*a*) These units are designed to stiffen or load the controls to simulate the stiffening effect of

air passing over the control surfaces of an airplane in flight.

(*b*) Three of these units are employed, one being connected to the rudder control, one to the elevator control, and the other to the aileron control.

(15) INTERCONNECTOR BOX. (*See figures* 63 *and* 72.)

(*a*) The interconnector box, located on the floor of the fuselage beneath the pilot's seat, serves as a terminus for the various electrical circuits in the fuselage.

(*b*) Current is distributed through this terminus to the flap control, landing gear, and propeller pitch control device, the transmitters for the remote indicating instruments, the fuselage control box, and to the trainer instrument panel.

d. OPERATOR'S DESK. (*See figure* 9.)—The operator's desk is located conveniently near the trainer and houses the following equipment:

(1) RADIO. (*See figure* 51.)—The radio equipment provides a means of reproducing for the student the aural and visual radio indications encountered in actual flight. This makes possible the practice of problems involving radio navigation, orientation, and instrument landing procedures.

(*a*) The radio equipment is located in the center drawer of the operator's desk. It contains the necessary controls and switches for reproducing the various aural and visual signals.

(*b*) Mike and earphones for the student are located in the fuselage, thus providing two-way communication between the student and operator. Additional sets of earphones are available at the operator's desk, permitting other students to listen in while problems are being flown by the student in the trainer.

(*c*) All signals between the operator's desk and the trainer fuselage are carried over wired circuits. Actual radio transmission is not employed.

(2) RADIO RANGE KEYER. (*See figure* 57.)—The radio range keyer is located in the radio control chassis. It automatically keys the steady tone produced by the various oscillators into A-N or E-T signals, landing markers, fan markers, and station identification signals.

(*a*) The main cam assembly with its several pairs of call letters may be replaced in a few seconds with an assembly providing an entirely different set of letters.

(*b*) The keyer is operated by a small constant-speed electric motor.

(3) INSTRUMENT LANDING SYSTEMS.—Three types of instrument landing systems may be simulated with the radio equipment, the system desired being selected at the operator's desk.

(*a*) Army Air Force System—Army-Cross Pointer. (See figure 54.)

(*b*) Navy System—Cross Pointer. (See figure 55.)

(*c*) British System—Standard Beam Approach. (See figure 56.)

(4) AUTOMATIC RECORDER. (*See figure* 6.)

(*a*) The automatic recorder, located on the operator's desk, is connected electrically to the trainer and accurately traces on a chart or map, the course flown by the student in the trainer.

(*b*) The automatic recorder travels on three wheels, geared together in such a manner that directional control is effective with all three wheels at the same time. (See figure 114.)

(*c*) The simulated flight path of the trainer is transmitted to the automatic recorder by two synchronous teletorque motors, one of which is located in the base of the trainer and the other in the center of the automatic recorder.

(*d*) Power is supplied by two constant-speed synchronous telechron motors geared to the two driving wheels of the automatic recorder. The third wheel, which is an idler wheel, is equipped with an inking roller which does the marking on the chart or map.

(5) REMOTE INSTRUMENT CASE. (*See figures* 70 *and* 71.)—The remote instrument case is located on the top of the operator's desk. Duplicate altimeter, vertical-speed, and air-speed indicators are mounted in the panel, as well as the landing system indicator.

(6) RADIO COMPASS CONTROL.—This unit is located on the operator's desk and provides a means by which the operator may control the radio compass bearings indicated on the radio compass indicator on the instrument panel in the trainer fuselage.

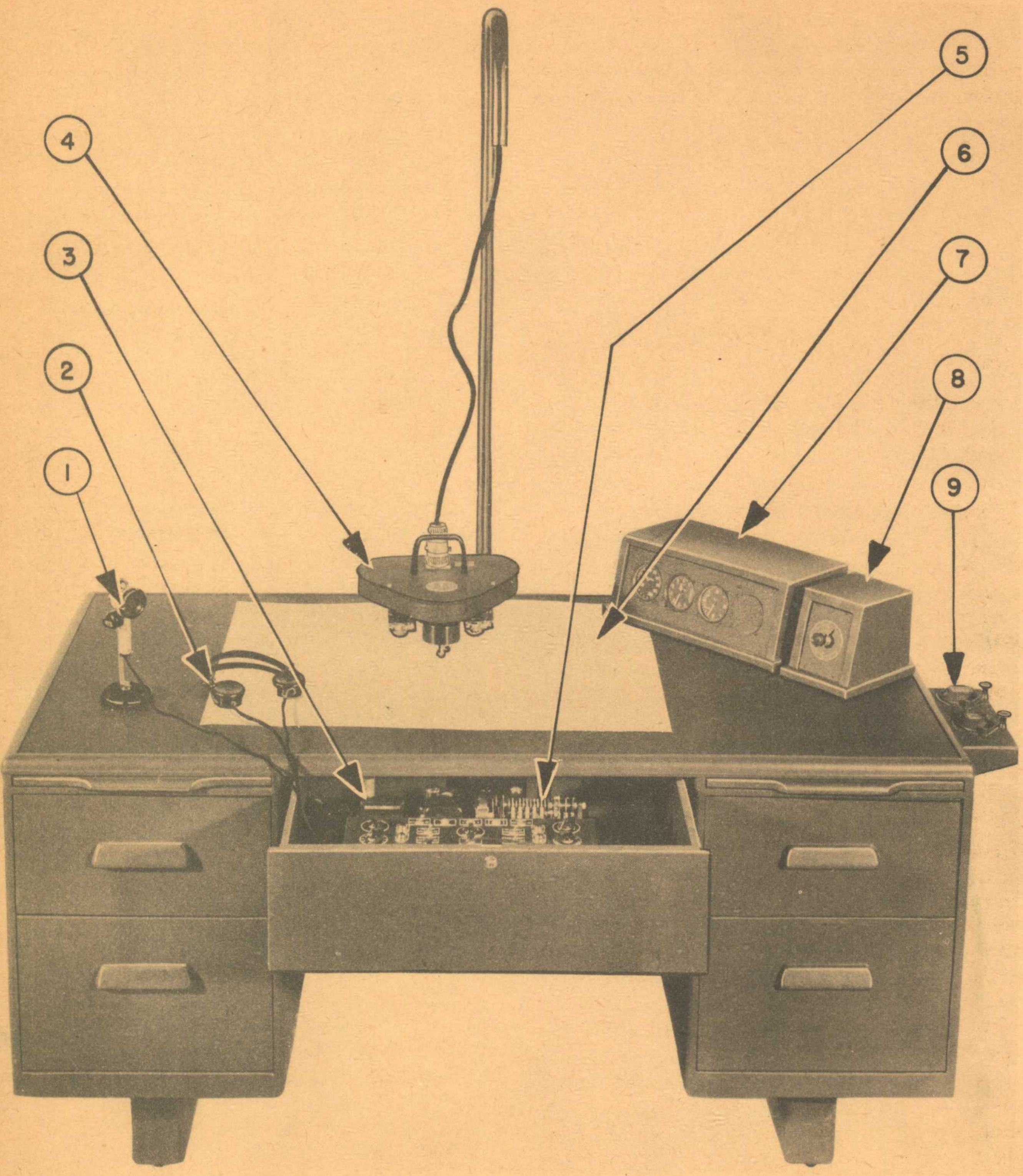


Figure 9—Operator's Desk

1. *Operator's Microphone*
2. *Operator's Head Set*
3. *Radio Chassis*
4. *Automatic Recorder*
5. *Keyer*
6. *Chart*
7. *Remote Instrument Case*
8. *Automatic Radio Compass*
9. *Operator's Wind Direction and Wind Velocity Controls*

(7) WIND DIRECTION AND WIND SPEED CONTROL.—This unit is attached to the end of the desk and is connected by flexible shafts to the wind drift mechanism in the base of the trainer. It consists of two dials and movable cranks, by means of which the operator may introduce wind from any angle at speeds up to 60 mph into the problem being flown in the trainer.

SECTION III
PRINCIPLES OF OPERATION

1. VACUUM.

a. To clearly understand the functioning of the trainer, a knowledge of vacuum is necessary.

b. Theoretically, vacuum is a space with absolutely nothing—not even faint traces of air—in it.

c. Only partial vacuum—space from which only a portion of the air has been removed—is utilized in the trainer.

d. Normal atmospheric pressure at sea level is 14.7 pounds per square inch and is 11.8 pounds per square inch at an elevation of 5,000 feet above sea level (the approximate highest elevation at which people live in large numbers). We are so accustomed to living in this condition of atmospheric pressure that we think nothing of it. Atmosphere so permeates all things under normal conditions—all buildings, machines, the tissues of our bodies—that we are not conscious of its tremendous power possibilities.

e. Take a paper bag empty of everything but air. Gather up the top of the bag about your finger, making a small opening, apply it to your lips and draw out the air. Instantly, the bag collapses. The pressure of the ordinary atmosphere outside, when the air inside is removed, is sufficient to absolutely flatten the bag. A bellows acts in the same way. When even a part of the air is removed, the pressure is sufficient to develop considerable power as the bellows collapses.

f. If we used a glass or metal tank instead of a bag we would be able to connect a gage to it and measure the difference between the pressure inside and that on the outside. If we had 14.7 pounds per square inch outside and only 10.7 pounds inside, the gage would show the difference—4 pounds of vacuum or pressure differential. One method of measuring the degree of vacuum is with a mercury gage, or manometer. A manometer is a U-shaped glass tube with the open ends up, filled a little less than half full with mercury. With a rubber tube attached to one of the open ends of the glass and the other end of the rubber tube connected to the tank, the height the mercury is displaced will indicate the degree of vacuum. The difference in height between the two columns of mercury in the U-glass is measured in inches and the indication read as *inches of mercury*. It takes roughly one pound of pressure differential to give an indication of two inches of mercury or, as it is sometimes expressed, 2 in. Hg.

g. When we utilize partial vacuum we are reducing the inside pressure and it is the outside air trying to force its way in that is working for us. It is the outside air pushing against the mercury through the open end of the glass U tube that raises the mercury column in the opposite end. The column will rise until the extra weight of the lifted column equals the pressure differential; thus when we measure the column we know the pressure differential.

h. Because power created by an air pressure differential is so positive, sensitive, and amply sufficient, it is particularly adaptable to produce necessary trainer motion, as well as action of linkages and instruments.

i. A distinct advantage in the use of vacuum as a source of power is that in making connections of vacuum hose to metal pipes, fittings, and instruments, little attention need be given except that a snug fit be obtained because the outside pressure on connections causes them to hold even more tightly.

2. VACUUM TURBINE.
(*See figure* 7.)

a. The trainer vacuum supply is produced by a centrifugal type turbine or blower, using four stages (four impellers). The impellers are mounted directly on the armature shaft of the 3/4 hp universal type motor which supplies the power.

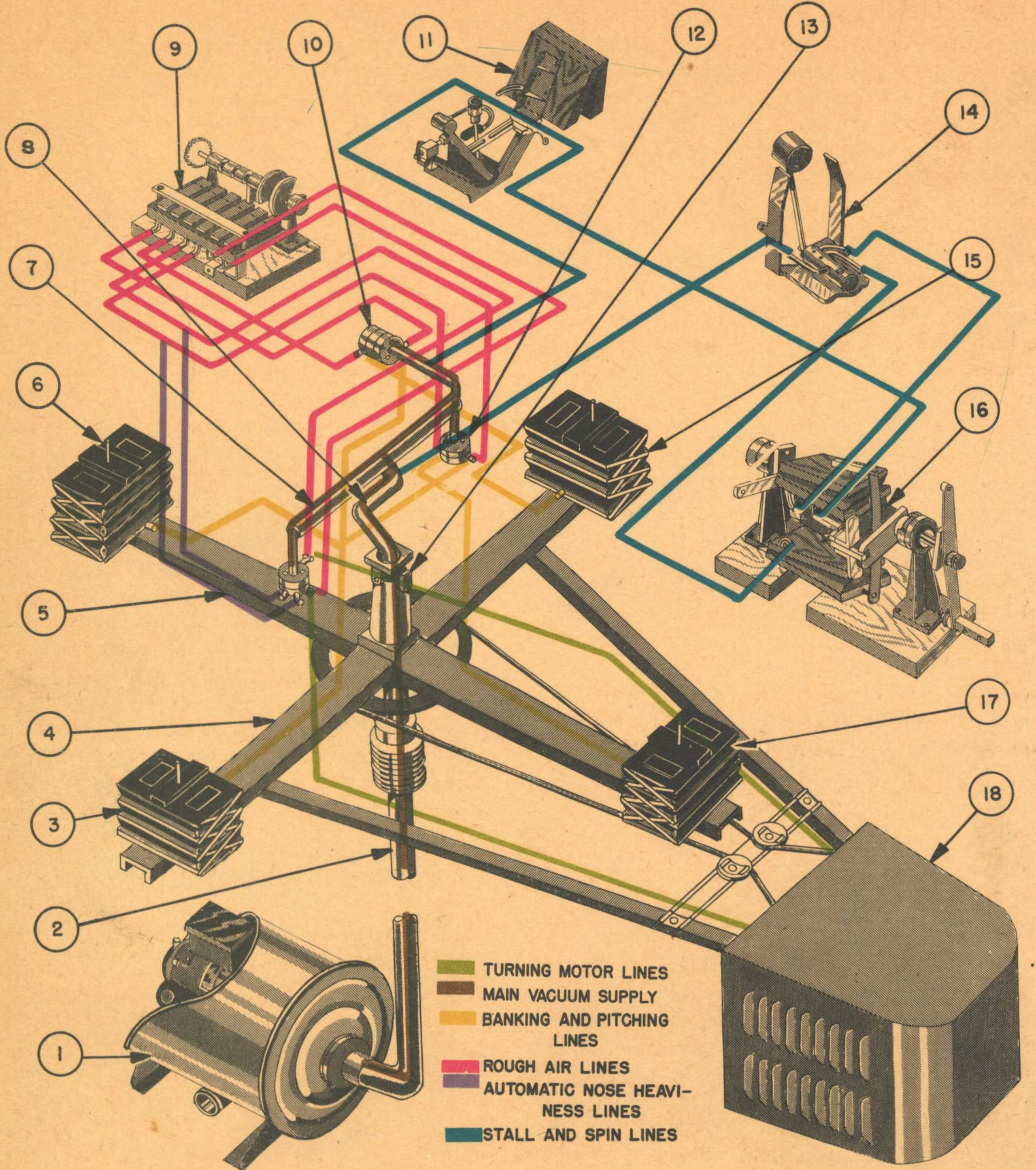


Figure 10—Vacuum System

1. *Vacuum Turbine*
2. *Main Spindle*
3. *Right Banking Bellows*
4. *Octagon Cross*
5. *Rudder Valve*
6. *Rear Pitching Bellows*
7. *Main Air Transfer Manifold*
8. *Conductor Elbow*
9. *Rough Air Generator*
10. *Aileron Valve*
11. *Stall Valve*
12. *Elevator Valve*
13. *Universal Joint*
14. *Spin Valve*
15. *Left Banking Bellows*
16. *Spin Trip Assembly Bellows*
17. *Front Pitching Bellows*
18. *Turning Motor*

b. The unit operates on 115 volts and displaces air at the rate of 12 cubic feet per minute to provide vacuum at approximately 4-3/8 in. Hg. It has been found that the trainer will operate satisfactorily at any degree of vacuum above 4 in. Hg. The remaining 3/8 in. Hg constitutes a reserve, or safety factor, for efficient operation. If the vacuum being supplied to the trainer by the turbine is tested at some point within the trainer, it will be about 1/4 in. Hg lower than if measured at the turbine.

c. Under conditions where the noise or heat produced by the turbine and motor are objectionable, it may be relocated outside the trainer room and connected to the trainer with tubing having the same inside diameter and wall strength.

CAUTION

If the turbine is located outside the trainer room, extreme care must be exercised to insure that it is protected from sand or dirt.

d. The 3/4 hp universal motor operates at from 7,000 to 8,000 rpm. It will operate on either alternating or direct current, also on any frequency from 25 cycles to 60 cycles. During normal operation it draws 9.0 amperes. Its speed and, in turn, the degree of vacuum produced is partially controllable by adjustment of the end bell.

e. The turbine motor is equipped with a filter which reduces to a minimum the possibility of interference with nearby radio receivers. This filter is located in a small box mounted on top of the unit and consists of two condensers across the line with their center connection grounded.

f. To protect the turbine motor in case of an overload, a circuit breaker (magnetic switch) is located in the base terminal box. In the event of an overload in the turbine circuit, a bi-metallic disk is heated by a heater unit which expands the disk and opens the circuit of the actuating coil. This releases the armature of the coil, causing the breaker points to open the turbine circuit. When the bi-metallic disk cools sufficiently to close the contacts controlling the actuating coil, the breaker contacts are again closed, completing the circuit to the turbine motor which resumes normal operation.

g. The intake end of the blower is connected with flexible fabric-covered rubber hose to the bottom of the main spindle of the trainer by means of a metal transfer elbow which permits the spindle to revolve without loss of vacuum.

h. At the top of the spindle, connection is made through the conductor elbow to a distributing manifold from which vacuum lines lead to the main valves and, through them, to the bellows, motor, and instruments throughout the trainer. (See figure 10.)

3. TURNING.

a. The turning motion of the fuselage about the vertical axis is produced by a vacuum operated turning motor, mounted on brackets attached to the octagon and extending out under the front of the fuselage.

b. A round leather belt connects the driving pulley on the turning motor with a large fixed pulley (sheave) attached to the base of the trainer. Thus, the turning motor pulls itself (with the octagon and the fuselage) around the sheave.

c. The turning motor is reversible and consists of two banks of valves, each bank connected by a separate vacuum line with the rudder valve. The two-way rudder valve (figure 17) is connected by linkage to the rudder pedals in such a manner that when right rudder is applied, the right-hand bank of the motor operates, causing the trainer to turn to the right. Applying left rudder causes a reverse action and the trainer turns to the left. When vacuum is being applied to one bank of the motor, the opposite bank is idling, being vented to atmosphere through the rudder valve.

d. In order to maintain proper tension on the turning motor belt, a belt tightener (figure 11) is provided. This consists of two idler pulleys, mounted on slide rods, which are in turn attached to the angle iron supports of the turning motor. The

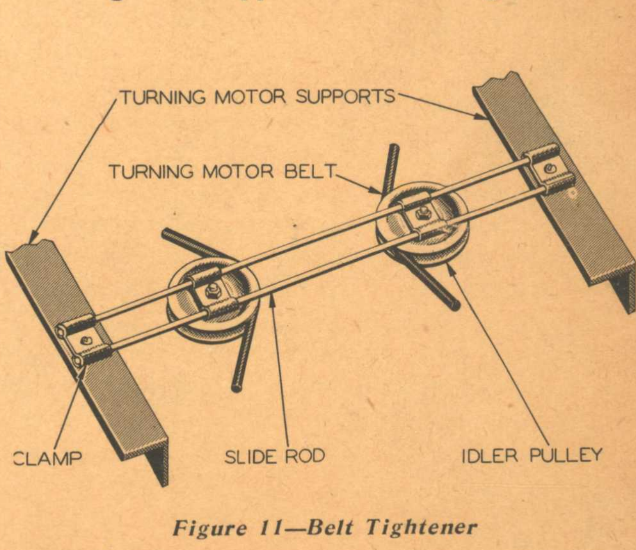


Figure 11—Belt Tightener

pulleys are adjustable and moving them toward each other increases the tension.

4. BANKING.

a. Banking motion is obtained by two of the four large bellows located under the fuselage in the revolving octagon, one to the right of and the other to the left of the universal joint (figure 5). When the vacuum turbine is operating, these two bellows are exerting a downward pull on the fuselage on both sides of the universal joint by reason of a small amount of vacuum being applied equally to each bellows. So long as this downward pull is equal on both sides of the fuselage, the trainer remains level, laterally.

b. Vacuum is applied to these two bellows through the two-way aileron valve (figure 15). A compensator link rod connects the aileron valve to an arm on the torque shaft which extends along the center line of the fuselage a few inches above the trainer floor. The torque shaft is connected to the interchangeable wheel and stick control, so that movement of the control wheel or stick to the right or left operates the aileron valve, causing more vacuum to be applied to one bellows while less vacuum is applied to the opposite bellows, thus increasing the downward pull on one side of the fuselage and decreasing the downward pull on the opposite side, causing the trainer to bank.

5. CLIMBING AND DIVING.

a. Nose-up or nose-down motion of the trainer is obtained by two of the four large bellows in the revolving octagon located in front of and behind the universal joint (figure 5).

b. These two bellows, like the banking bellows, are both exerting an equal downward pull on the fuselage both fore and aft of the universal joint when the trainer is in a level position with respect to the longitudinal axis. These two bellows are controlled by a two-way elevator valve, similar to the aileron valve, which is connected by a link rod directly to the control column. Consequently, pushing the wheel or stick forward actuates the elevator valve so that vacuum pressure is increased in the front bellows and decreased in the rear bellows, causing the trainer to nose down. When the wheel or stick is pulled back, the reverse of this action takes place and the trainer noses up.

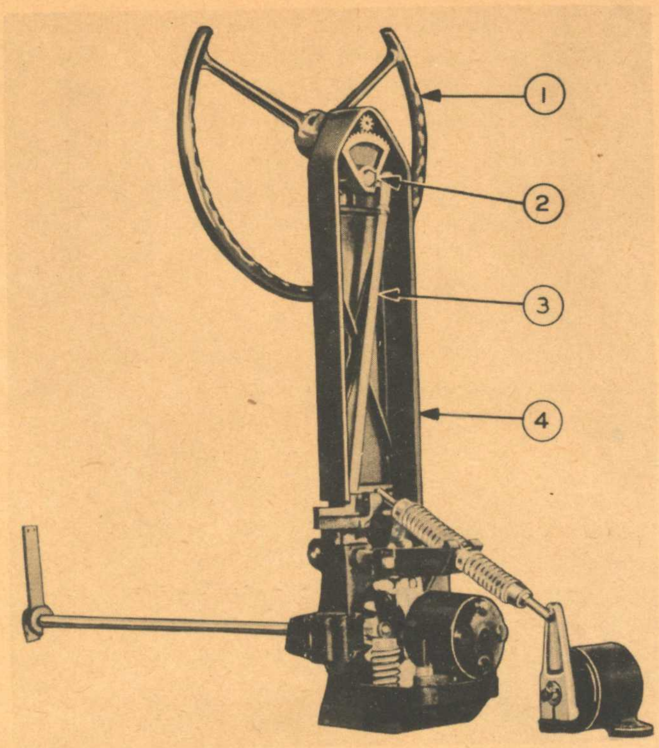


Figure 12—Wheel Control—Interchangeable with Stick Control

1. *Control Wheel*
2. *Control Sector Gear and Pinion*
3. *Control Column Link Rod*
4. *Control Column*

6. INTERCHANGEABLE WHEEL AND STICK CONTROL.

(*See figures* 12 *and* 13.)

a. Aileron and elevator control is accomplished with the interchangeable wheel and stick mounted on the fuselage floor in front of the pilot's seat.

b. This unit provides a ready method of changing from wheel control to stick control or vice versa.

c. Aileron and elevator control pressure is accomplished by means of a spring action set in the base of the control column.

d. The spring controlling the elevator pressure is adjustable.

e. An additional pair of lighter springs are provided in the tool kit. When it is desirable for the operator to simulate airplanes with a light "feel" on the aileron control, these lighter springs may be installed.

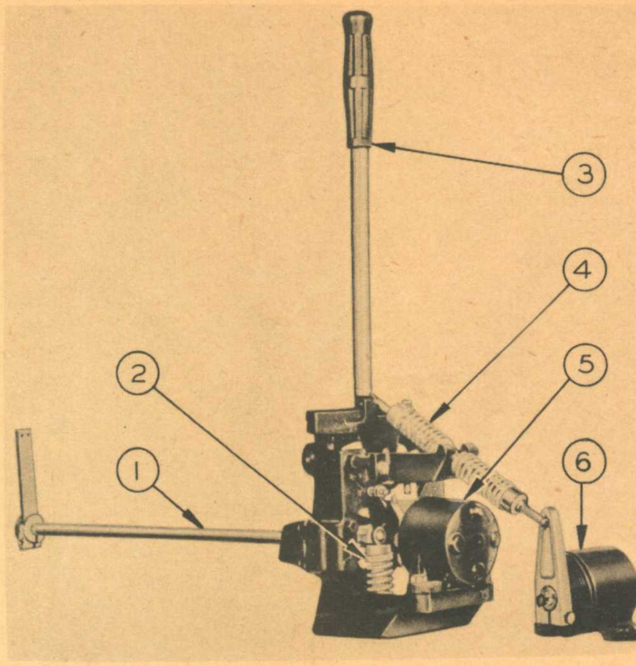


Figure 13—Stick Control—Interchangeable with Wheel Control

1. *Torque Shaft*
2. *Aileron Control Spring*
3. *Stick*
4. *Elevator Control Spring*
5. *Aileron Control Simulator*
6. *Elevator Control Simulator*

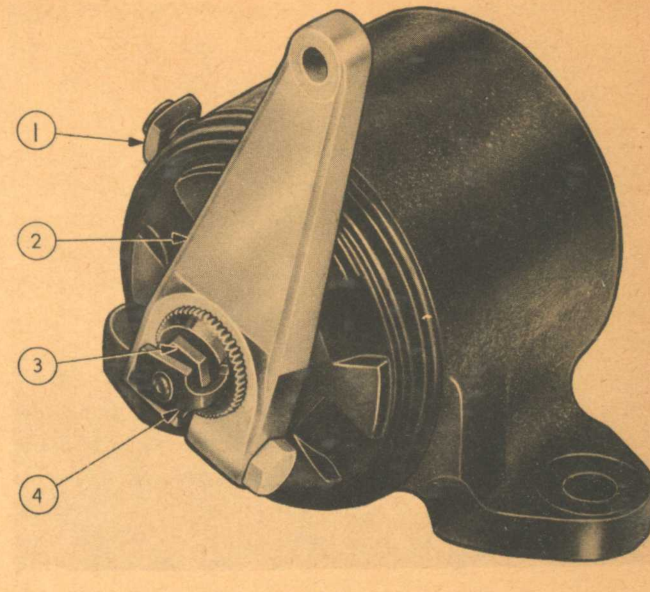


Figure 14—Slip-Stream Simulator

1. *Filler Hole*
2. *Lever Arm*
3. *Packing Nut*
4. *Resistance Adjusting Nut*

7. RUDDER CONTROL.

a. Rudder control is accomplished through the rudder pedals, these being connected by cable to the rudder bar, which acts as a walking beam, balancing the movement between the right and left pedals.

b. The rudder valve, which primarily controls the vacuum applied to the turning motor, is operated by linkages to the rudder bar.

8. CONTROL LOADING.

(*See figure* 14.)

a. Control loading is accomplished in the trainer by the use of three slip-stream simulators, one of which is connected to the aileron control, one to the elevator control, and one to the rudder control.

b. These units are designed to load the controls to simulate the stiffening effect caused by air passing over the control surfaces of an airplane in flight.

c. The body of the unit contains vanes, mounted on a large shaft, operating in fluid-filled compartments. The fluid flows from one side of each vane to the other through a valve which can be adjusted to furnish the desired resistance to elevator, aileron, or rudder control movement. A large shaft protrudes from the center of the unit, to which a lever arm is attached. The lever arm is connected by a link rod to the control. A rectangular head resistance adjusting nut is located on the end of the shaft with an ear on one side bent over to form a pointer. A hex nut, between the adjusting nut and lever arm, holds a packing in place to prevent leakage around the valve shaft.

9. THROTTLE CONTROL.

(*See figure* 27.)

a. The throttle is connected by linkage to the walking beam on the pitch action shaft which, in turn, is connected on one side by linkage to the climb-dive valves and on the other side to the air-speed regulator bellows and the manifold pressure (or tachometer) regulator bellows. The climb-dive valves are connected by vacuum lines to the climb-dive tank and to the diaphragms of the transmitters for the altimeter and vertical-speed indicator, and to the stall valve and spin valve assemblies. The air-speed regulator bellows is connected by a vacuum line through the air-speed damping tank to the diaphragm of the transmitter for the air-speed indi-

cator. The manifold pressure (or tachometer) regulator bellows is connected by a vacuum line directly to the manifold pressure indicator (or tachometer) on the trainer instrument panel.

b. These mechanical linkages, vacuum operated assemblies, and instruments are so arranged that forward movement of the throttle causes proportionately increased indications on the altimeter, air-speed indicator, and manifold pressure indicator (or tachometer), together with proportionate indications of rate of climb on the vertical-speed indicator, while closing the throttle causes proportionately decreased indications on the altimeter, air-speed indicator, and manifold pressure indicator (or tachometer), and indications of rate of descent on the vertical-speed indicator.

c. The stall valve, spin valve, and air-speed regulator bellows are connected by vacuum lines in such a manner that when air-speed indications are decreased to a certain point, as a result of throttle movement and/or trainer attitude, the trainer stalls and spins.

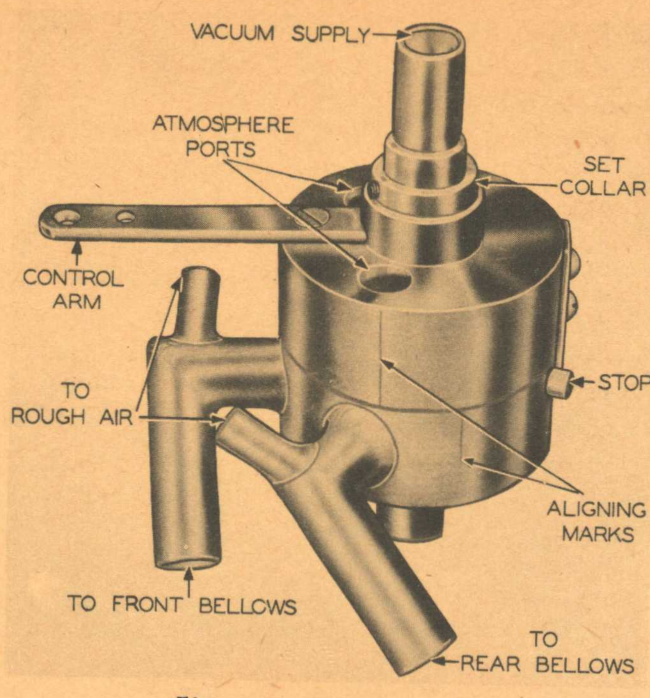


Figure 16—Elevator Valve

10. MAIN VALVES.

a. GENERAL.—Three main valves are used in the trainer, namely, rudder valve, aileron valve, and elevator valve. All are somewhat similar in design and operation insofar as their primary function of causing turning, banking, and pitching (climbing and diving) movements of the trainer is concerned. (See figure 18.) Certain mechanical differences have been incorporated in the aileron valve and rudder valve (figures 15 and 17) in order to make possible their secondary function of causing "nose heaviness during turn" and "automatic bank with turn," respectively.

b. AILERON VALVE. (*See figure* 15.)—This valve is mounted in a horizontal position just behind the pilot's seat in the left-hand side of the fuselage and is connected to and operated by right or left movement of the wheel or stick. Movement of the trainer caused by the aileron valve is around the longitudinal axis and is called "banking."

c. ELEVATOR VALVE. (*See figure* 16.)—The elevator valve is mounted in a vertical position un-

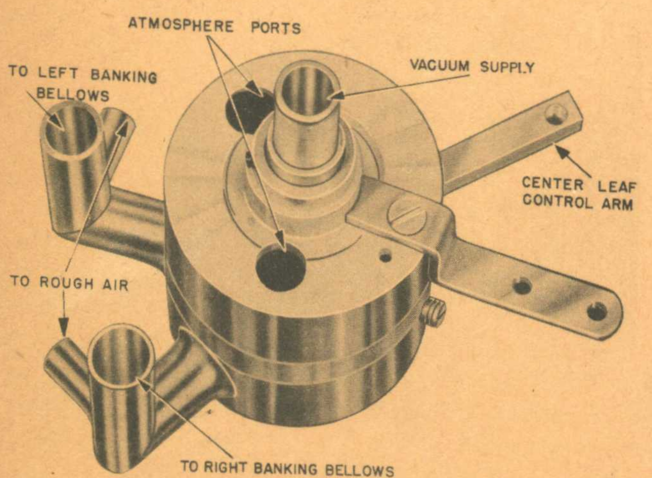


Figure 15—Aileron Valve

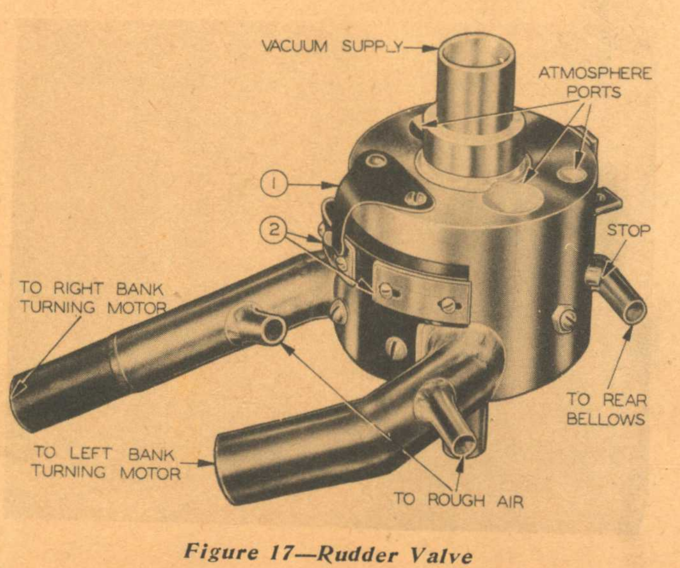


Figure 17—Rudder Valve

der the pilot's seat on the left-hand side and toward the rear of the fuselage. It is connected to and operated by the fore and aft movement of the wheel or stick. Movement of the trainer caused by the elevator valve is around the lateral axis and is called "pitching," or "climbing and diving."

d. RUDDER VALVE. (*See figure* 17.)—This valve is mounted in a vertical position under the pilot's seat in the right-hand side of the fuselage. It is connected to and operated by the rudder pedals. Movement of the trainer caused by the rudder valve is around the vertical axis and is called "yawing" or "turning."

11. DETAIL OPERATION OF MAIN VALVES.

(*See figure* 18.)

a. Vacuum is applied to the valve through the stem (A) which is connected through the holes at (B) to port (C) in the upper half of the valve. In the centered position this port is slightly overlapping the two ports (P) in the lower half. In this position, due to this overlap, a small amount of vacuum is being applied to both bellows to which the valve is connected, or, in the case of the rudder valve, to both banks of the turning motor, and both will be exerting an equal pull on the trainer fuselage.

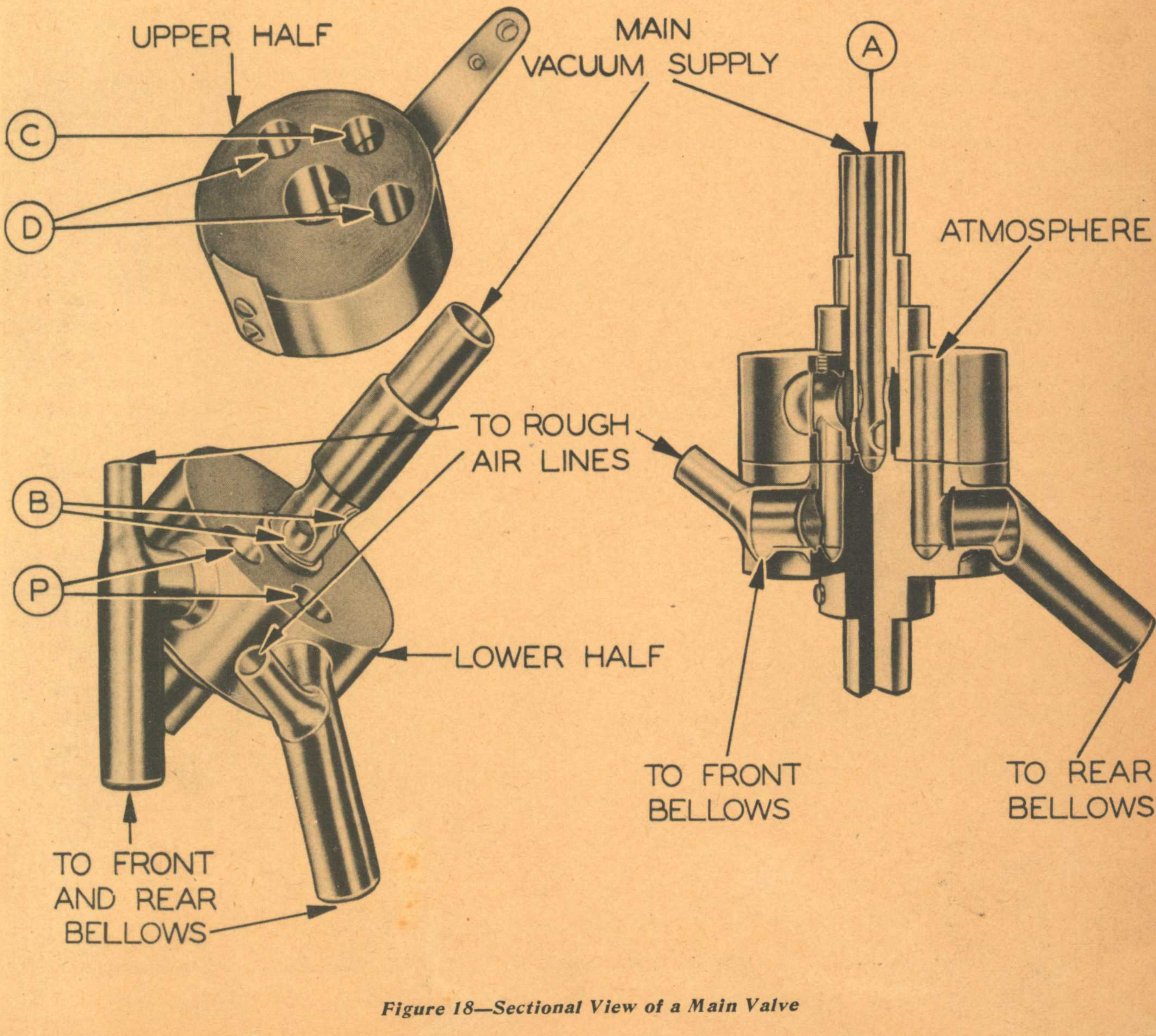


Figure 18—Sectional View of a Main Valve

b. Movement of the aileron, elevator, or rudder controls rotates the upper half of the valve, moving the vacuum port (C) over one of the ports (P) in the lower half of the valve and moving one of the ports (D) in the upper half of the valve over the other port (P) in the lower half of the valve. Thus when vacuum is applied to one bellows through port (C), the opposite bellows is vented to atmosphere through one of the ports (D), causing banking, pitching, or turning movement of the fuselage, depending on which control is moved.

12. NOSE HEAVINESS DURING TURN.

a. Nearly all airplanes have a tendency automatically to nose down during a turn without forward movement of the elevator control. This tendency is reproduced mechanically in the trainer by means of special ports in the rudder valve (figure 19), connected through the rough air line to the front and rear (dive and climb) bellows. From a study and comparison of figures 18 and 19, it can be seen that these additional ports are so arranged that when the upper half of the rudder valve is turned in either direction, one or the other of two small vacuum ports comes over port (F) in the lower half of the valve, thereby applying vacuum through the elbow to the front (dive) bellows rough air line. At the same time, one or the other of the two small atmosphere ports in the upper half of the valve will be over recess (R) in the lower half, thereby admitting atmosphere through the elbow to the rear (climb) bellows rough air line. Thus, with vacuum being applied to the front (dive) bellows and atmosphere being admitted to the rear (climb) bellows whenever the trainer is turning in either direction, the downward pull exerted on the front bellows, together with a decrease in vacuum in the rear bellows caused by the admission of atmosphere, causes the trainer to nose down slightly when turning.

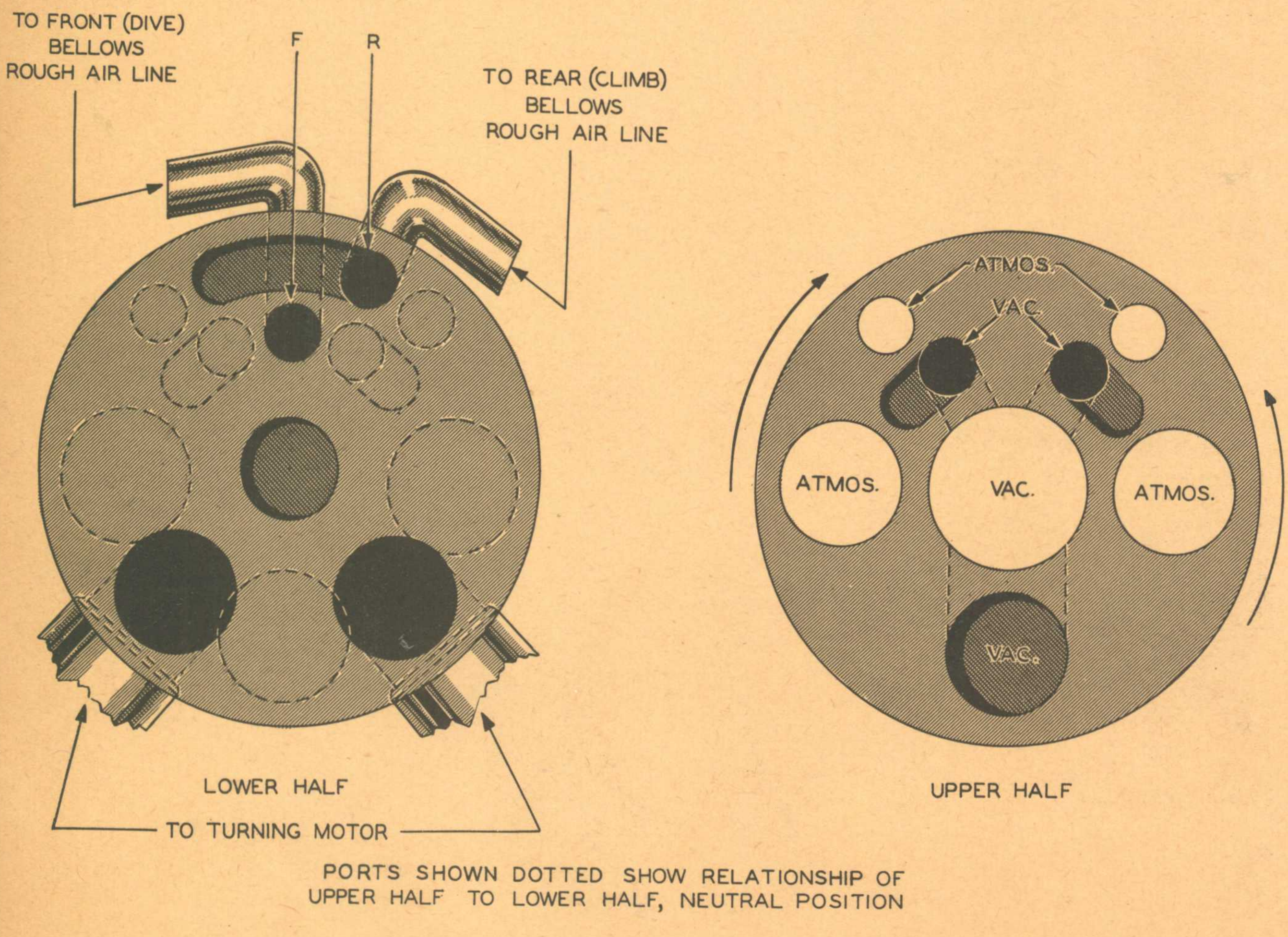


Figure 19—Rudder Valve, Nose Heaviness Type

b. This tendency of nose heaviness during a turn is overcome in the trainer, as in an airplane, by moving the wheel or stick slightly to the rear whenever a turn is made.

c. The proper proportion of nose heaviness during a turn is arrived at in the design of the valve and the size and location of the ports and no provision has been made for further adjustment.

d. Due to the positioning of the ports in the valve, the extent of nose heaviness is in direct proportion to the rapidity of the turn or the distance the rudder pedal is pushed forward.

13. AUTOMATIC BANK WITH TURN.

a. Nearly all airplanes have a tendency to bank automatically, without the aid of the ailerons, whenever rudder is applied. This tendency is reproduced mechanically in the trainer by interconnecting the rudder pedals by linkage with a specially constructed type aileron valve (figure 20).

b. By comparing the automatic bank with turn type aileron valve (figure 20) with the main valve (figure 18), it can be seen that, in order to reproduce the automatic bank with turn, a center leaf has been placed between the upper and lower halves of the valve.

Note

On trainers, Link Serial No. 4395 to 5550, inclusive, the center leaf of the aileron valve is connected by linkage to the bell crank and then, by means of the aileron valve compensator rod, to the spin trip

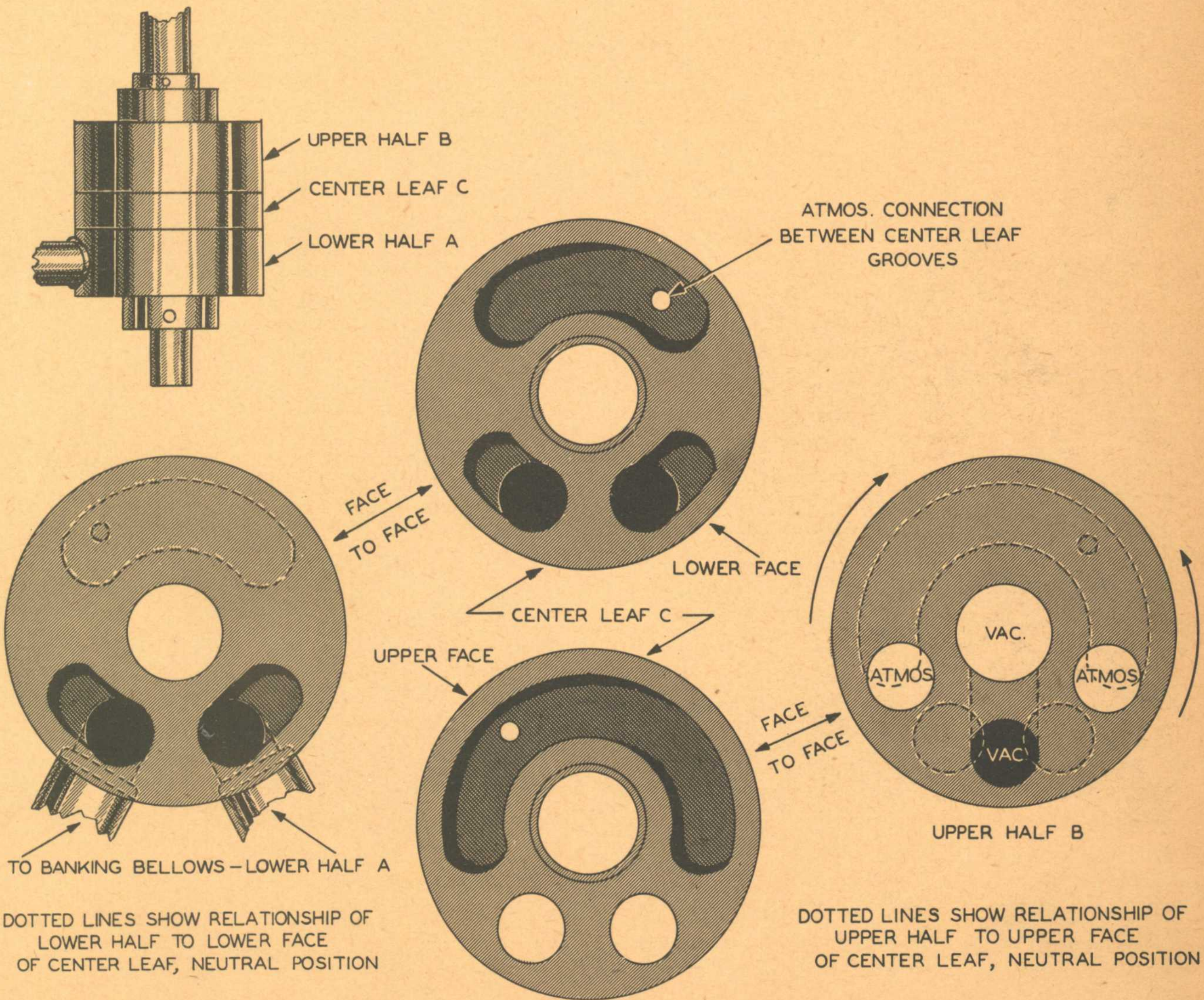


Figure 20—Aileron Valve, Automatic Bank

walking beam. The top of the spin trip walking beam is connected by a link rod to the rudder bar which is actuated by movement of the rudder pedals. It can be seen, therefore, that movement of either the right or left rudder pedal rotates the center leaf of the aileron valve, causing the trainer to bank when turning.

On trainers beginning with Link Serial No. 5551, the center leaf is connected by linkage to a bell crank which is connected by a link rod directly to the rudder bar. (See figure 24.) This bell crank assembly increases the effectiveness of the automatic bank with turn feature, causing the operation and effect of the controls to more closely simulate the automatic bank with turn characteristic of an airplane. It also eliminates the necessity of applying full opposite aileron control to recover from a bank and, when the proper angle of bank has been attained during a turn, the application of only a very little opposite aileron control is necessary to maintain it.

c. When the trainer is maintaining straight and level flight, the two ports in the center leaf (C, figure 20) are in line with the two ports in the lower half of the valve that leads to the two banking bellows, while the vacuum port in the upper half of the valve is between and slightly overlapping the two ports in the center leaf. It can be seen, therefore, from a study of the main valve (figure 18) and the automatic bank with turn type aileron valve (figure 20), that rotating either the center leaf or the upper half of the valve would place the vacuum port in the upper half of the valve, in line with one of the ports in the lower half of the valve. At the same time, one of the atmosphere ports in the upper half would be in line with the other port in the bottom half of the valve. Vacuum would thus be applied to one of the banking bellows while atmosphere would be admitted to the opposite bellows, thereby causing the trainer to bank. As the upper half of the valve is connected to the wheel or stick control torque shaft and as the center leaf is connected by linkage to the rudder pedals, the trainer would be caused to bank either by right or left movement of the wheel or by application of right or left rudder. Also, as this center leaf is rotated in proportion to the extent to which the rudder pedal is pushed forward, the tendency to bank when turning is proportionate to the rapidity of the turn.

d. It will be noted that the ports in the center leaf (C, figure 20) are elongated on the side which faces the bottom or fixed portion of the valve. This has been necessary so that movement of the center leaf will not interfere with the application of vacuum through the lower half of the valve.

e. In order to prevent friction or binding between the three moving surfaces of the valve due to the constant vacuum pressure, the center leaf has been grooved on both sides and these grooves are connected by a small hole. As the groove on the upper surface of the center leaf is always in line with one of the atmosphere ports in the upper half of the valve, all three moving surfaces are always under normal atmospheric pressure.

14. AUTOMATIC TURN WITH BANK.

(*See figure* 21.)

a. Nearly all airplanes have a tendency to turn in the direction of the low wing when banking. This tendency is reproduced in the trainer by means of the bank turner assembly.

b. This assembly is located on the fuselage floor parallel to the lateral axis, with the link rod (8) connected to the octagon cross at the right of the longitudinal axis. Due to its location, the movement of the trainer about its lateral axis (climbing or diving) will have no effect upon this unit. However,

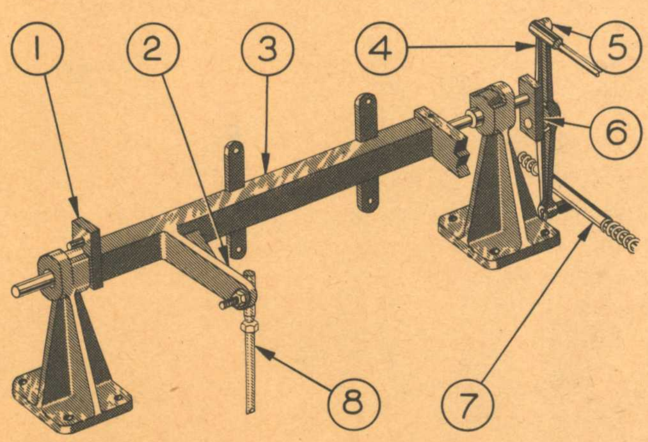


Figure 21—Bank Turner Assembly (without Spin Trip Assembly)

1. *Stop Arm*
2. *Link Rod Arm*
3. *Shaft*
4. *Link Rod to Rudder Bar*
5. *Walking Beam*
6. *Bell Crank*
7. *Compensator Rod to Rudder Valve*
8. *Link Rod to Octagon Cross*

when the trainer is banked, the distance is varied between the fuselage floor and the octagon. This, in effect, moves the horizontal arm (2) up or down, which rotates the square shaft (3), moving the bottom of the bell crank (6). Since the top of the walking beam (5) is stationary, due to the centered position of the rudder pedals, the walking beam pivots at point (5), imparting motion to the compensator link rod (7) which is connected to the rudder valve. This causes the upper part of the rudder valve to be rotated, which in turn causes the trainer to turn in the direction in which it is banked even though the rudder pedals are in a centered position.

c. As movement of the linkage connecting the bank turner assembly to the rudder valve is proportionate to the extent to which the trainer is banked, the tendency of the trainer to turn when banking is in direct proportion to the extent to which the wheel or stick is moved to the right or left.

d. This tendency to turn when banking is counteracted in the trainer, as in an airplane, by a slight application of rudder on the side opposite the low wing.

15. ROUGH AIR GENERATOR.

(*See figure* 22.)

a. The rough air generator is located in the rear of the fuselage and is operated by a small constant-speed electric motor. Current supply for this motor is controlled by the trainer main switch and it is, therefore, always in operation when the trainer is running.

b. The purpose of the rough air generator is to simulate in the trainer the effect of air currents or rough weather on an airplane. This is accomplished by means of six cam-operated flap valves on the rough air generator, which are connected into the vacuum lines leading to the banking and pitching bellows and to the two banks of the turning motor.

c. The rough air generator is turned on or off by means of a crank located under the rear of the fuselage. Screwing in this crank raises the valves so that they make contact with their respective revolving cams. This crank may be partially screwed in to simulate varying degrees of rough air. The two cams that cause turning bumps, however, are held open 3/16 of an inch continuously by a T-shaped push rod, except that, when the rough air is cranked in, they are closed alternately by their respective cams.

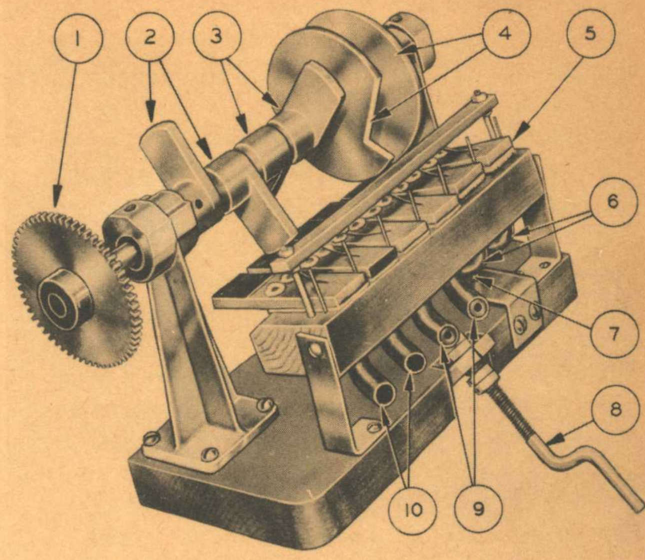


Figure 22—Rough Air Generator

1. *Drive Gear*
2. *Aileron Cams*
3. *Elevator Cams*
4. *Rudder Cams*
5. *Flap Valves*
6. *Rough Air to Rudder Valve*
7. *Adjustable Control for Rudder Flap Valves*
8. *Control Crank*
9. *Rough Air to Elevator Valve*
10. *Rough Air to Aileron Valve*

d. When the trainer is flying straight and level both of the banking bellows and both of the pitching bellows are exerting an equal downward pull on the fuselage. When one of the rough air flapper valves is opened by its cam, air is permitted to enter the main bellows to which the flapper valve is connected, decreasing the vacuum in that bellows and allowing the opposite bellows to pull one side of the fuselage down. Thus, a lateral or a pitching bump occurs whenever the corresponding rough air flapper valve is opened.

e. Bumps affecting the movement of the trainer about its vertical axis are caused in a different manner. Due to the construction of the rudder valve, a small amount of vacuum is being constantly applied to the vacuum lines leading to both banks of the turning motor. Two cam-operated flapper valves on the rough air generator are connected by tubing to the turning motor and are normally held open. Atmosphere is continually entering through these flapper valves and neutralizing or balancing the vacuum pressure which is being constantly applied through the rudder valve to both banks of the turning motor. However, when the rough air generator

is turned on, these flapper valves are alternately being closed momentarily by their cams, shutting off atmosphere, first to one bank of the turning motor, then to the other. This results in a momentary increase in vacuum pressure on alternate banks of the turning motor, causing the trainer to yaw, first in one direction, then in the other.

f. In other words, the mechanical arrangement of the cams and the rough air flap valves is such that, in the case of the pitching and banking bellows, a momentary leak of atmosphere is admitted alternately to each of the bellows and, in the case of the turning motor bellows, a constant leak of atmosphere is shut off momentarily to alternate banks of the turning motor.

16. STALLING—STALL VALVE ASSEMBLY.

a. When the speed of an airplane drops below a certain minimum, the airplane "stalls" and sometimes starts to "spin." This characteristic is built into the trainer and is a function of the stall valve (figure 23).

b. The bellows of this assembly is connected by tubing to the line leading from the air-speed regulator bellows to the air-speed indicator. Thus, the same amount of vacuum is applied to the stall valve bellows as to the air-speed indicator. At normal air speed this vacuum pressure is sufficient to keep the stall valve bellows collapsed and overcomes the tension of the spring on the stall bellows. In this position the inverted pendulum rests against the adjustable stop screw.

c. At normal air speed the pendulum is being held against the stop screw and atmosphere is continually entering the atmosphere vent in the three-way jet assembly between the line from the main vacuum supply and the line to the spin trip bellows. Due to a restriction built into the vacuum side of

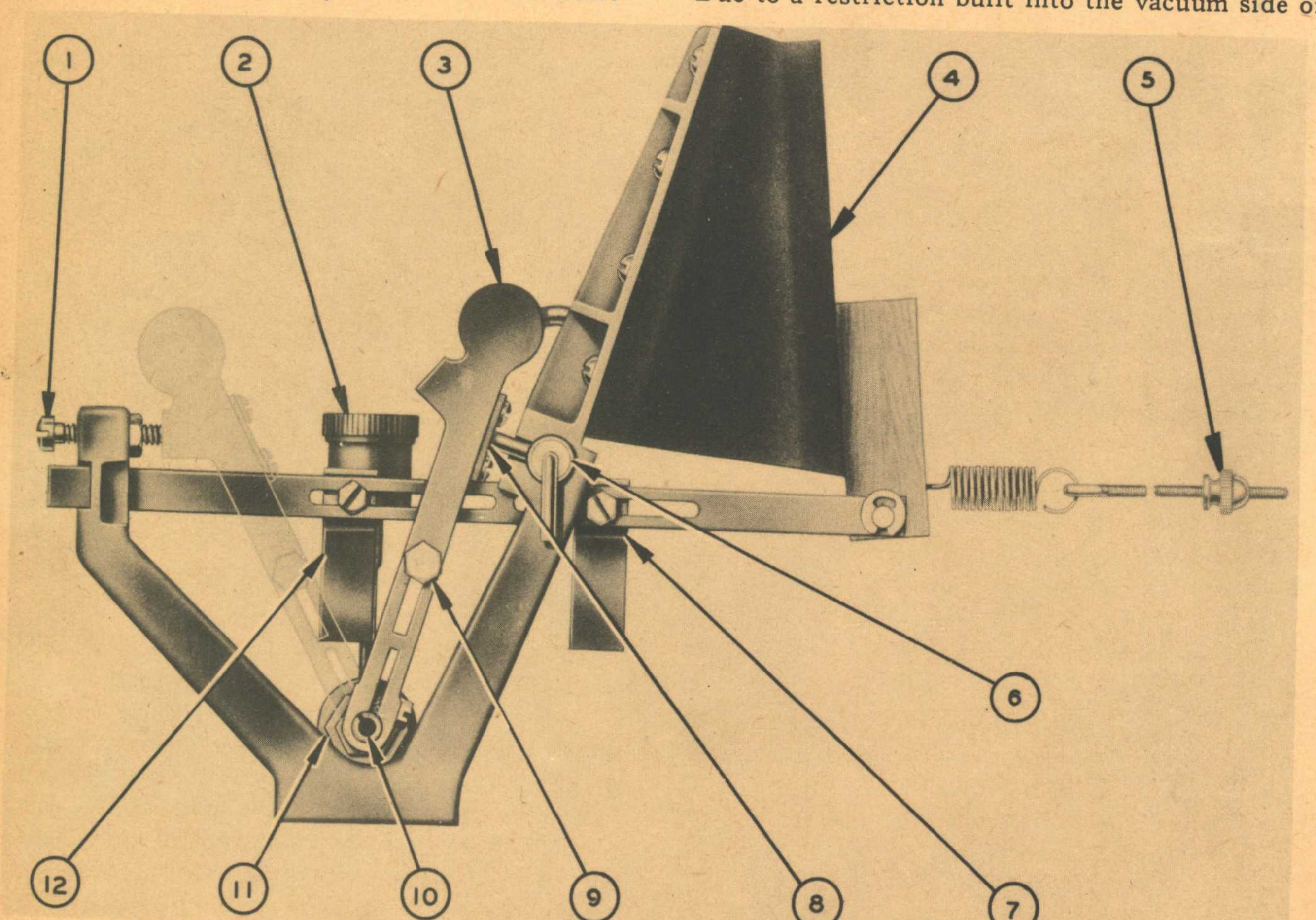


Figure 23—Stall Valve, Elevation

1. *Adjustable Stop Screw*
2. *Air Filter*
3. *Pendulum*
4. *Bellows*
5. *Adjusting Nut*
6. *Jet Assembly*
7. *Pick-up Pin*
8. *Atmosphere Vent*
9. *Mush Pin*
10. *Valve Needle*
11. *Valve Body*
12. *Recovery Pin*

this connection, the atmosphere entering the atmosphere vent is sufficient to reduce the vacuum to the spin trip bellows line so that the spin trip bellows remains expanded.

d. As the air speed is decreased, the vacuum in the stall bellows is correspondingly reduced. When it is reduced to a certain point, the spring tension is able to overcome the vacuum pressure and pulls the stall bellows open. As the bellows opens, the pendulum is pulled back against the atmosphere vent. This closes the atmosphere vent and applies vacuum to the spin trip bellows, thereby collapsing the bellows, causing the trainer to spin.

e. As the stall valve pendulum moves away from the adjustable stop screw, the needle inside the valve body is turned away from the valve seat permitting a gradually increasing flow of atmosphere to pass through the valve into the climb-dive tank, thus decreasing the vacuum pressure in the tank, causing the altimeter and vertical-speed indicators to show loss of altitude indications. The period from the time the needle valve starts to open until the actual stall and spin occur is known as the "mush" period. This is reflected on the altimeter and vertical-speed indicators by lowered altitude indications.

f. The anti-spin valve (4, figure 89) is included as a part of the stall valve assembly to prevent the trainer from spinning when the ignition is first turned on. The anti-spin valve consists of a vacuum operated plunger which prevents the operating of the stall valve until an air speed has been attained in the trainer beyond the established stalling speed.

Note

The anti-spin valve mechanism in the stall valve is standard equipment on all instrument flying trainers AN 25-50-1, beginning with Link serial No. 7501.

17. AUTOMATIC SPIN.

(*See figure* 24.)

a. Automatic spin is accomplished by means of a bellows and latch mechanism, called the spin trip assembly (1), which is mounted on the shaft (C) of the bank turner assembly. Three bellows are used —one (J) to work the latch, and the other two, (L) and (M), to provide energy for actuating the rudder valve when the trainer is spinning.

b. These parts are mounted on a hollow shaft (C) which is free to turn on the solid shaft (A) of the bank turner assembly. Arm (B), which is connected downward through the fuselage floor, by linkage (10), to the octagon, is permanently attached to the hollow shaft on which bellows and latch are mounted. Arm (I) which carries the latch is also anchored to this hollow shaft, by reason of being attached to the small bellows, while arm (H) is secured by a setscrew to the solid inner shaft. As long as the latch is engaged with arm (H), the solid shaft is locked to the hollow shaft and the entire unit functions only to provide the automatic turn-with-bank feature.

c. When the air speed falls below stalling speed, the pendulum of the stall valve closes the atmosphere vent in the stall valve assembly, thereby applying vacuum to the line that leads to the small bellows (J) which is linked to the latch (K). The vacuum closes this bellows and raises the latch out of the notch in arm (H). The hollow shaft is still held rigid by arm (B) but, with the latch disengaged, arm (H) and the inner shaft are free to turn.

d. Of the top and bottom bellows, one or the other is always under vacuum. Assume that, at the moment, vacuum is applied to the top bellows. This bellows, then, is being collapsed and, when the latch releases arm (H), the following action takes place:

(1) The bellows (L) closes, and through rod (N) and link (O) pushes arm (H) down, rotating the solid inner shaft. The bell crank (D) on this shaft is swung forward and the walking beam (6), pivoting at point (E), pulls the rudder valve, through link rod (F), wide open, causing the trainer to spin.

(2) If the bottom bellows (M) had been under vacuum instead of the top one, the same action would have taken place, except that the spin would have been in the opposite direction.

18. SPIN VALVE.

(*See figure* 25.)

a. This unit is simply a two-way valve connected on one side to the vacuum supply, and on the other to the two spin bellows. It has an inverted pendulum connected to the valve stem. The position of the pendulum determines to which of the two bellows vacuum shall be applied and, hence, the direction in which the trainer will spin. The pendulum normally falls toward the lowest side of the fuselage but also can be thrown over by application of rudder through a fork which extends back from the rudder bar (18, figure 24).

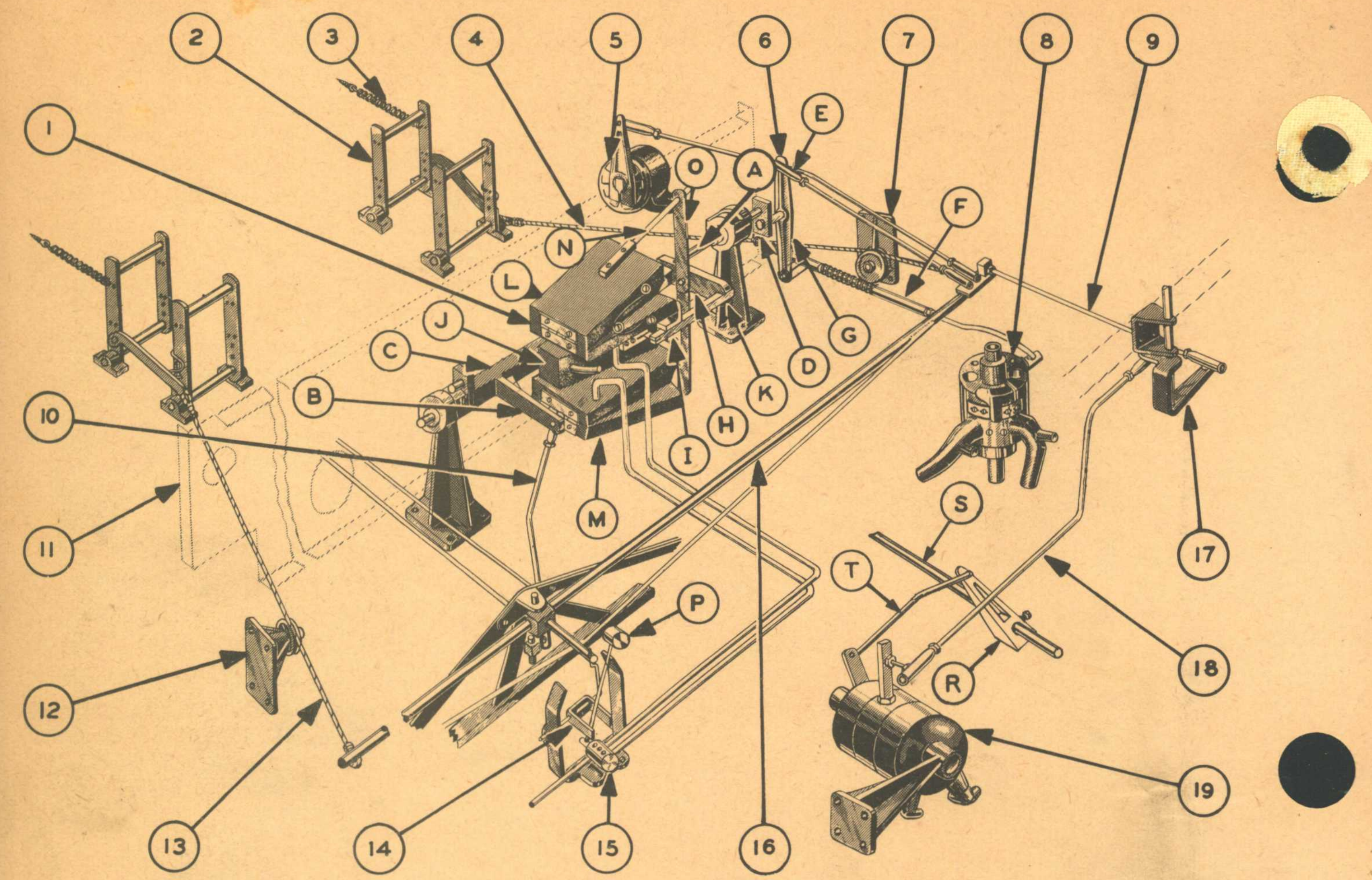


Figure 24—Direction Control (Schematic)

1. *Spin Trip Assembly*
2. *Double Rudder Pedal*
3. *Rudder Pedal Spring*
4. *Right Rudder Cable*
5. *Slip-Stream Simulator (Rudder)*
6. *Spin Trip Walking Beam*
7. *Rudder Cable Pulley Guide*
8. *Rudder Valve*
9. *Link Rod to Aileron Valve Bell Crank*
10. *Bank Turner Link Rod*
11. *Baffle Plate*
12. *Rudder Cable Pulley Guide*
13. *Left Rudder Cable*
14. *Rudder Bar Fork to Spin Valve*
15. *Spin Valve Assembly*
16. *Rudder Bar*
17. *Aileron Bell Crank*
18. *Aileron Valve Link Rod*
19. *Aileron Valve*

b. As long as the air speed remains below stalling speed the small bellows controlling the spin trip latch will remain collapsed and the latch will remain raised where it cannot engage the notch in arm (H, figure 24). During this time, full application of rudder will throw the spin valve pendulum over and apply vacuum to the other spin bellows. As this bellows collapses it will swing the arm (H) past the latch and move the rudder valve around to fully open in the opposite direction. This will reverse the direction of spin but normal rudder control cannot be regained until normal air speed is recovered.

c. To recover from a spin in the trainer, it is necessary to nose down—to regain normal air speed—and apply full opposite rudder. When normal air speed is recovered, the pendulum of the stall valve moves away from the atmosphere vent (figure 23) allowing atmosphere to enter, which decreases the vacuum to the small bellows. This bellows then expands (pulled open by springs) and returns the latch to its locking position. As full rudder is applied, the spin valve pendulum is thrown over and the opposite spin bellows starts to collapse, attempting to swing arm (H, figure 24) past the latch.

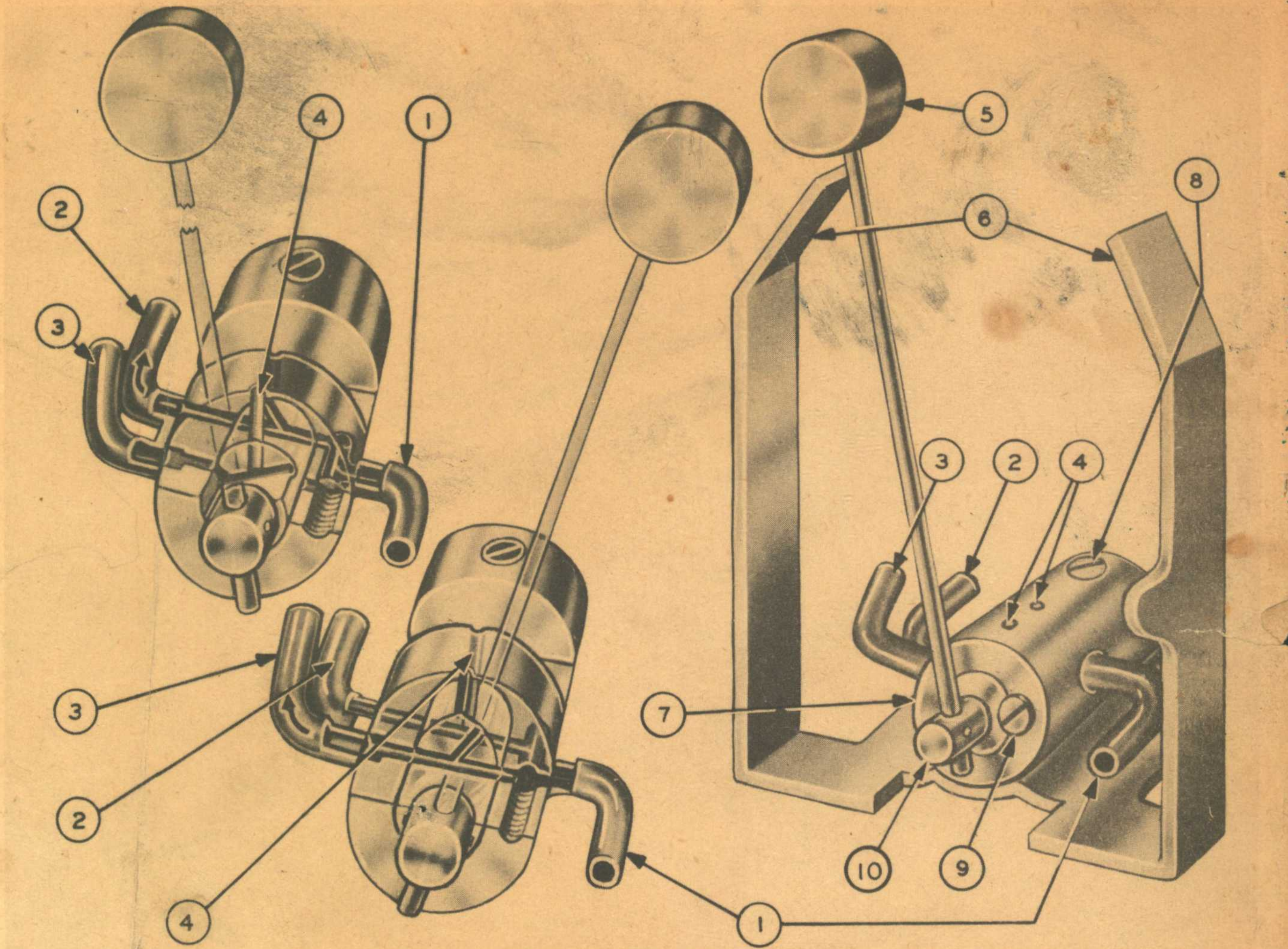


Figure 25—Spin Valve (cutaway)

1. *Main Vacuum Supply*
2. *Connections to Lower Spin Bellows*
3. *Connections to Upper Spin Bellows*
4. *Atmosphere Ports*
5. *Pendulum*
6. *Stops*
7. *Valve Body*
8. *Base Screw*
9. *Stem Screw*
10. *Stem*

The latch, now being in its normal position, engages the notch in arm (H) and locks the solid shaft that carries the walking beam, restoring normal rudder control.

19. REGULATOR BELLOWS.

(*See figure* 26.)

a. Regulator bellows are used to control the amount of vacuum applied to the air-speed indicator transmitter diaphragm and to the manifold pressure indicator. These regulator bellows are connected through coiled springs to the walking beam on the pitch action shaft, so that the effects of nose-up or nose-down attitude of the trainer, combined with throttle setting, result in correct indications of air speed and engine speed.

b. Fitting (8) is connected by tubing direct to the main vacuum supply. Fitting (7) on the air-speed regulator bellows is connected by tubing through the air-speed damping tank (3) to the diaphragm of the air-speed transmitter and, on the manifold pressure regulator bellows, is connected directly to the diaphragm of the manifold pressure indicator. (Identical bellows are used for both instruments.)

c. When the trainer is turned on and vacuum is applied to the bellows at (8), air is drawn out and the bellows starts to collapse but the coiled spring (13) is tending to hold it open. Air continues to be

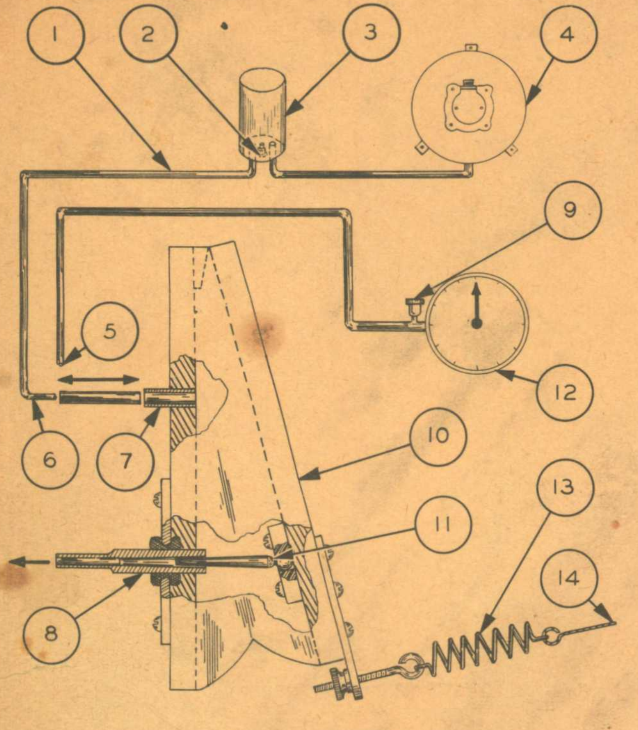


Figure 26—Regulator Bellows for Air-Speed Indicator or Manifold Pressure Indicator

1. *Air-Speed Line*
2. *Bleed Hole Filter*
3. *Air-Speed Damping Tank*
4. *Air-Speed Transmitter*
5. *Line to Manifold Pressure Regulator Bellows*
6. *Line to Air-Speed Regulator Bellows*
7. *Fitting Connected to Indicator*
8. *Fitting Connected to Vacuum Supply*
9. *Bleed Hole Filter*
10. *Bellows*
11. *Needle Valve*
12. *Manifold Pressure Indicator*
13. *Spring*
14. *Wire to Pitch Action Shaft*

drawn out until there is sufficient vacuum pressure created to overcome the tension of the spring. As the spring tension is overcome and the bellows closes, the needle valve (11) shuts off the supply of vacuum. The damping tank in the line to the air-speed transmitter has a small bleed hole equipped with a filter (2). As air leaks in through this bleed hole the vacuum in the bellows decreases until it can be overcome by the spring, which then pulls the bellows open slightly. The needle valve will be opened only enough to permit the passage of just enough air to balance the leak in the damping tank and this condition will remain until the pull on the spring is changed.

d. The air-speed indicator and the manifold pressure indicator are simply vacuum gages and indicate the pressure differential inside their respective regulator bellows.

e. Since the wire (14) is linked to the walking beam on the pitch action shaft, any change in trainer attitude or throttle setting will vary the tension of the regulator bellows spring.

f. By closing the throttle or pulling up the nose of the trainer, the regulator bellows spring is slackened off slightly and, therefore, less vacuum will be needed in the bellows to overcome it. Consequently, the air-speed transmitter or manifold pressure indicator to which this bellows is connected will fall back to a lesser indication.

20. CLIMB-DIVE VALVES.

(*See figure* 28.)

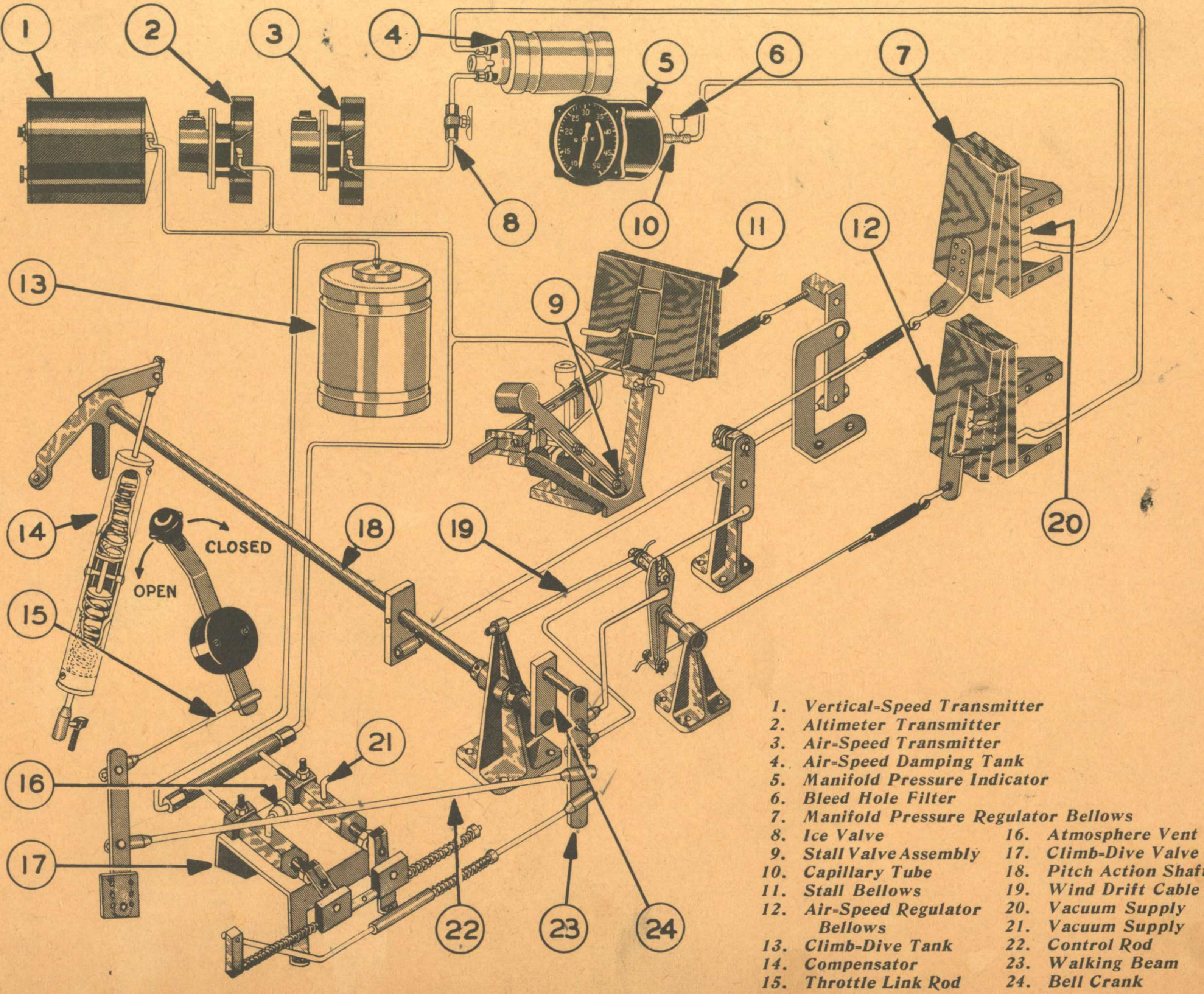
a. The climb-dive valve assembly is located on the floor of the fuselage and consists of two separate valves, mounted and controlled as a unit. Both valves are connected to the line leading to the climb-dive tank (figure 27) and to the lines leading to the diaphragms of the altimeter and vertical-speed indicator transmitters. When one valve is open, the other remains closed.

b. The climb valve controls the amount of vacuum applied to the altitude system. When this valve opens, air is drawn out of the climb-dive tank and a condition is created inside the tank similar to the decrease of atmospheric pressure as altitude is gained in an airplane.

c. The dive valve controls the amount of atmosphere allowed to enter the altitude system. With this valve open, atmosphere is allowed to flow back into the altitude system and the altimeter then shows decreased altitude indications.

d. Gain or loss of pressure in the altitude system is reflected in lower or higher readings of the altimeter, while the rate at which altitude is gained or lost, as shown on the vertical-speed indicator, depends directly on how far the climb or dive valve is opened.

e. Operation of the climb-dive valves is controlled either by throttle movement, by change in the fore and aft attitude of the fuselage, or by a combination of both. Throttle connections are through direct linkage to the climb-dive valves, while fuselage attitude is reflected by means of a compensator attached to the octagon cross and operating through the pitch action shaft. (See figure 30.)



1. Vertical-Speed Transmitter
2. Altimeter Transmitter
3. Air-Speed Transmitter
4. Air-Speed Damping Tank
5. Manifold Pressure Indicator
6. Bleed Hole Filter
7. Manifold Pressure Regulator Bellows
8. Ice Valve
9. Stall Valve Assembly
10. Capillary Tube
11. Stall Bellows
12. Air-Speed Regulator Bellows
13. Climb-Dive Tank
14. Compensator
15. Throttle Link Rod
16. Atmosphere Vent
17. Climb-Dive Valve
18. Pitch Action Shaft
19. Wind Drift Cable
20. Vacuum Supply
21. Vacuum Supply
22. Control Rod
23. Walking Beam
24. Bell Crank

Figure 27—Instrument Control (Schematic)

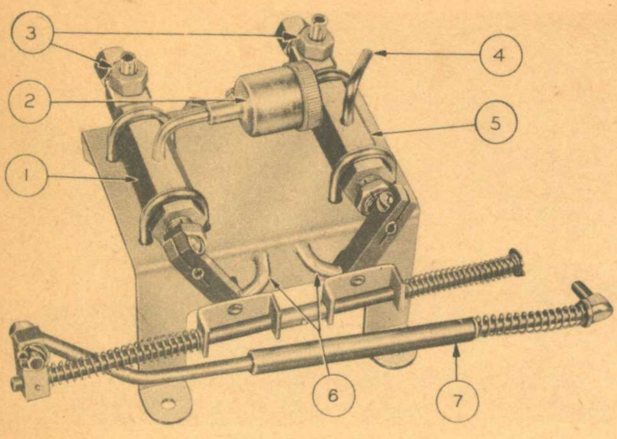


Figure 28—Climb-Dive Valve

1. *Dive Valve*
2. *Air Filter*
3. *Limit Valves*
4. *Connection to Vacuum*
5. *Climb Valve*
6. *Stops*
7. *Compensator Link Rod*

f. As in an airplane, movement of the throttle is invariably accompanied by a change in the fore and aft attitude of the fuselage. The linkages are arranged in the trainer in such a manner that the results of change of throttle position and change in the fore and aft attitude of the trainer are combined to build up correct readings on both the altimeter and vertical-speed indicator.

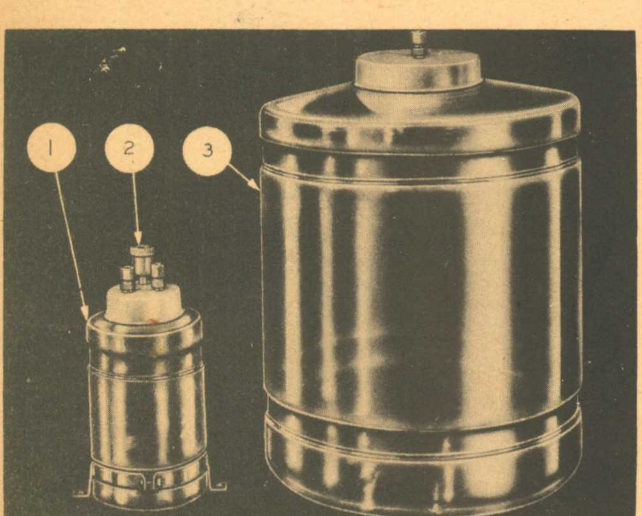


Figure 29—Air-Speed Damping Tank and Climb-Dive Tank

1. *Air-Speed Damping Tank*
2. *Air Filter at Bleed Hole*
3. *Climb-Dive Tank*

21. TELEGON SYSTEM OF REMOTE INDICATION.

a. The Kollsman telegon system of remote indication is used in the trainer in order that identical instrument readings may be shown on duplicate sets of indicators.

b. The remote indicating system consists of a single transmitting unit, located at the source of measurement, and two indicating units, one of which is mounted on the instrument panel in the trainer fuselage and the other at the operator's desk.

c. The transmitter is a Kollsman telegon unit actuated by an instrument mechanism similar to standard aircraft instruments.

d. The indicator consists of a telegon unit structurally identical with the transmitter unit carrying the instrument dial and hand.

e. The following instruments are operated by the remote indicating system:

(1) Altimeter

(2) Air-speed Indicator

(3) Vertical-speed Indicator

f. Nine telegon motors are used in the system, each remote instrument requiring three telegons for its operation.

g. The external and internal wiring of a telegon unit is shown in (A) and (B) figure 31.

h. A top view of a telegon unit with the end bells and case removed, showing the arrangement of the terminals, is shown in (C) figure 31. This unit is inclosed in a steel shell and aluminum end bells.

i. A cross-sectional view of a telegon unit is shown in (D) figure 31. The unit consists of a spool assembly, four terminals, and two terminal insulators, the shell, and two end bells. The spool assembly contains the shaft assembly (K), the primary coil (M), and the phase windings (F-F′). The four terminals are connected to the primary coil and the phase windings.

j. Power for the remote indicating instruments is supplied by the telegon oscillator located in the base of the trainer. (See figure 111.)

22. AIR-SPEED INDICATOR.

(*See figure* 32.)

a. The air-speed indicator operates on vacuum supplied through the air-speed regulator bellows to

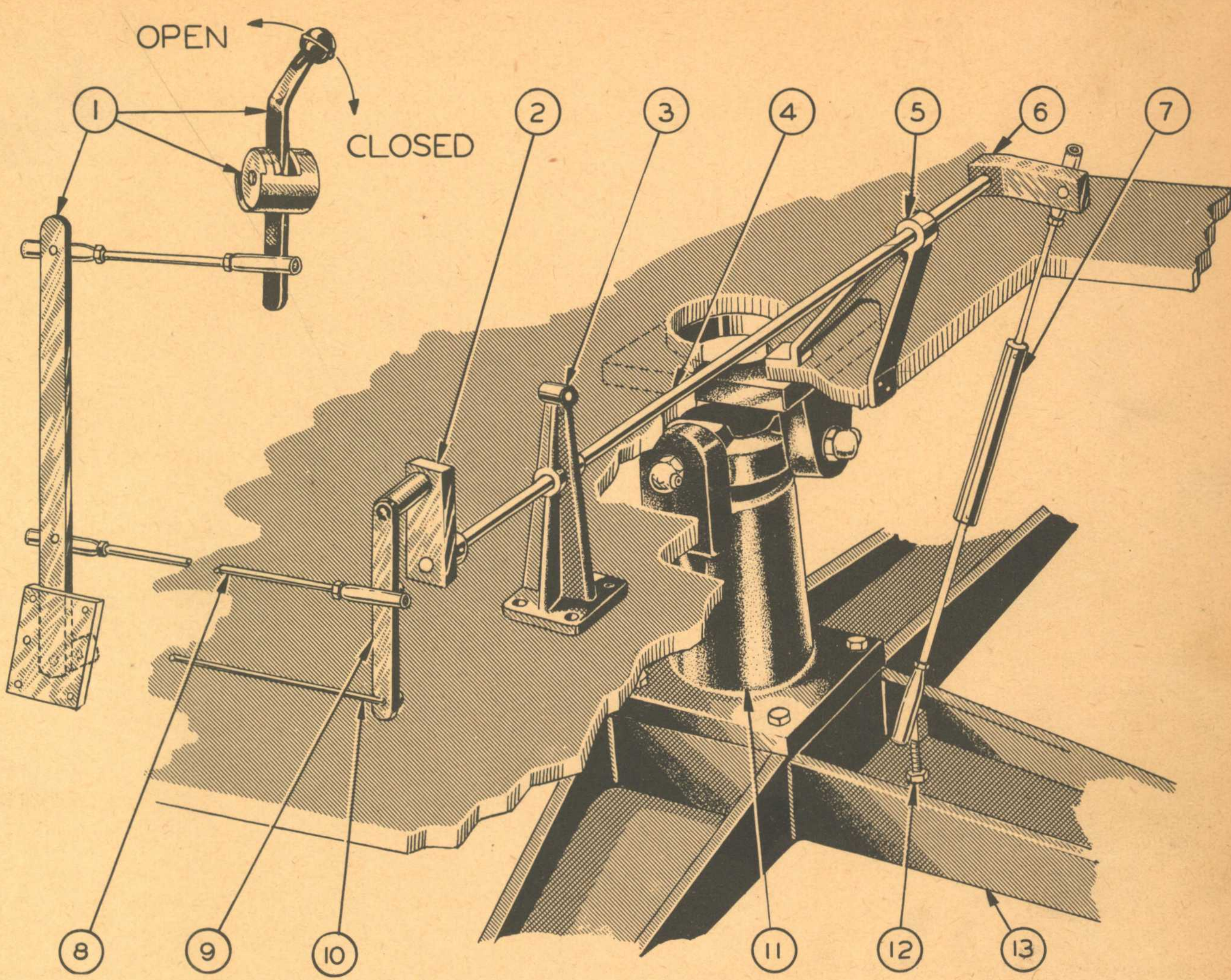


Figure 30—Pitch Action Assembly

1. *Throttle Assembly*
2. *Pitch Action Shaft Arm*
3. *Air-Speed Cable Bracket*
4. *Pitch Action Shaft*
5. *Pitch Action Shaft Bracket*
6. *Pitch Action Compensator Arm*
7. *Pitch Action Compensator*
8. *Throttle Link Rod to Pitch Action*
9. *Pitch Action Walking Beam*
10. *Climb-Dive Link Rod to Pitch Action*
11. *Universal Joint*
12. *Pitch Action Compensator Stud*
13. *Octagon Cross*

the diaphragm of the transmitter which is located in the rear of the trainer fuselage.

b. As the diaphragm of the transmitter is displaced by the application of vacuum, the armature of the telegon motor attached to the transmitter is rotated. This causes a corresponding rotation of the armatures of the telegon motors connected to the indicator on the trainer instrument panel and the indicator on the operator's desk.

c. The arrangement of the air-speed regulator bellows and connecting linkages is such that throttle setting and/or trainer attitude cause the proper vacuum to be applied to the diaphragm of the transmitter to give the desired reading on the indicators. (See figure 27.)

d. In order to obtain changes in air-speed indications similar to those received in actual flight, a damping tank (figure 29) has been installed in the line between the regulator bellows and the air-speed transmitter. To allow the pointers of the indicators to return to zero when the regulator bellows is collapsed as a result of closing the throttle or nose-up attitude of the trainer, the damping tank is provided with a bleed hole. The bleed hole is equipped

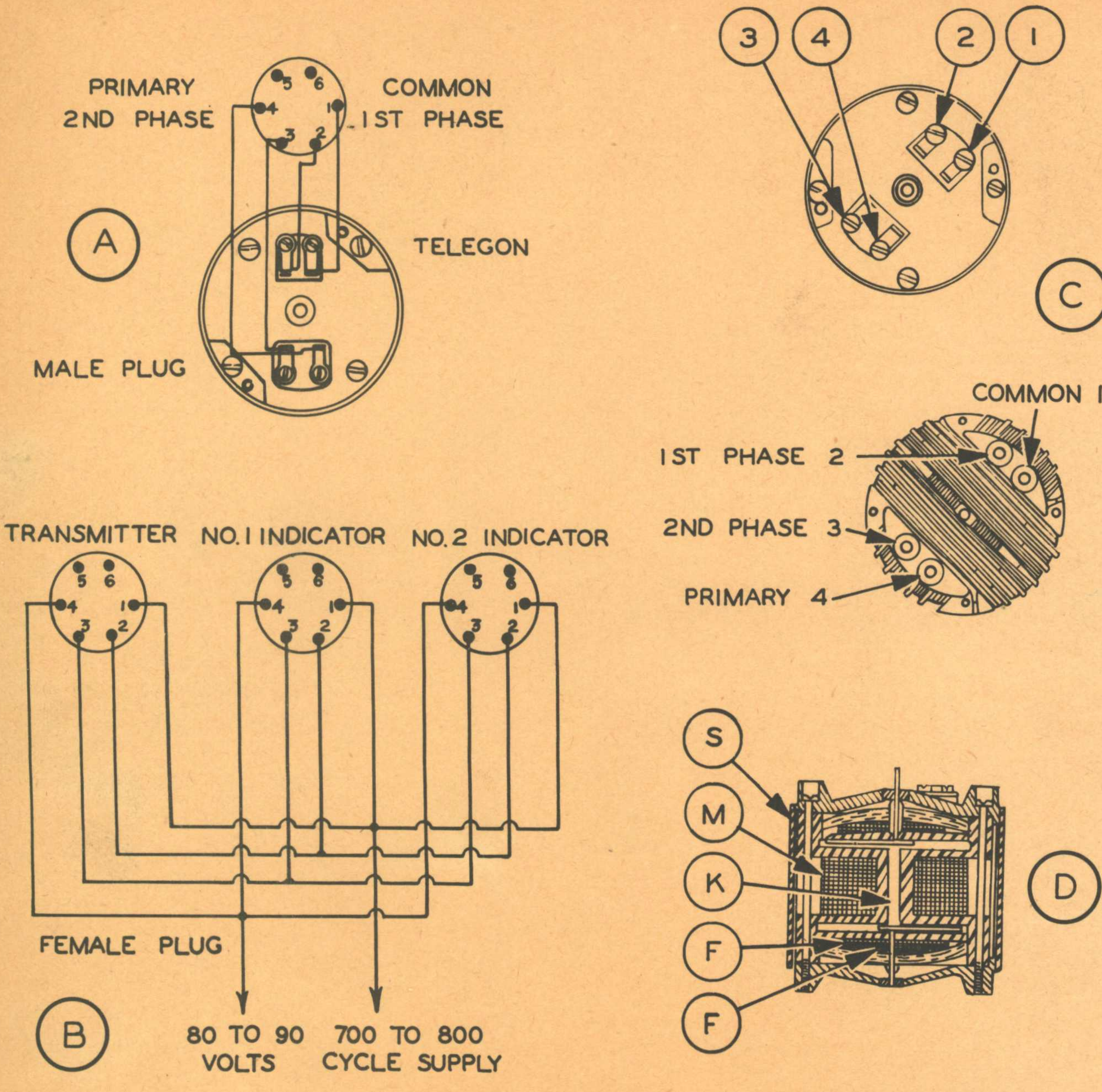


Figure 31—Telegon Unit

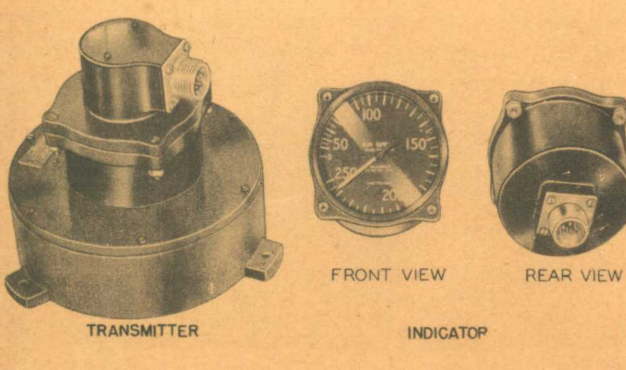


Figure 32—Air-Speed Indicator

with a filter to prevent its becoming clogged with dust or dirt. To further smooth out the action of the indicators a restriction, with an inside diameter of approximately .018 inch, is placed in the vacuum line near the point of connection with the air-speed transmitter.

23. ALTIMETER.

(*See figure* 33.)

a. The altimeter is a pressure indicating instrument used to indicate to the student in the trainer

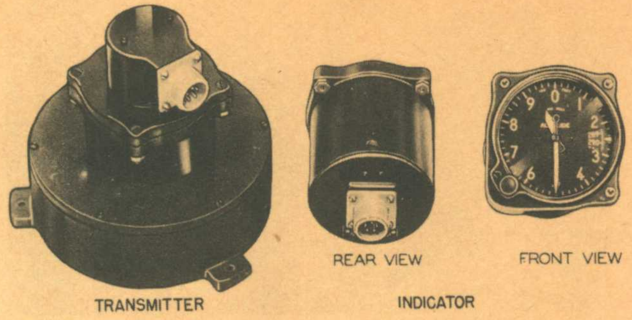


Figure 33—Altimeter Indicator

and the operator at the desk the simulated altitude of the trainer. The diaphragm of the altimeter transmitter is actuated by changes in vacuum in the trainer altitude system caused by the opening or closing of the climb-dive valves due to throttle setting and/or trainer attitude.

b. The diaphragm of the altimeter transmitter is connected to the vacuum line leading from the climb-dive tank. When vacuum is applied to the transmitter diaphragm, it rotates the armature of the transmitter telegon motor which, in turn, causes the armatures of the indicator telegon motors to rotate an equal amount, thus giving identical indications on the indicator on the trainer instrument panel and also on the indicator on the operator's desk.

c. The linkage between the diaphragm and the transmitter telegon motor is such that only one-half the normal reduction in pressure is required for the altimeters to indicate a specific altitude.

24. VERTICAL-SPEED INDICATOR.

(*See figure* 34.)

a. This instrument measures, and indicates to the student in the trainer and the operator at the desk, the rate of gain or loss of simulated altitude in hundreds of feet per minute.

b. Other specific uses for this instrument are as follows:

(1) To indicate ascent or descent.

(2) To aid in making banked turns without gain or loss of altitude.

(3) To aid in establishing predetermined constant and definite rates of descent when making instrument landings or approaches.

c. The vertical-speed indicator, like the altimeter, is a pressure indicating instrument and is operated by changes in vacuum pressure in the altitude system due to throttle setting and/or trainer attitude.

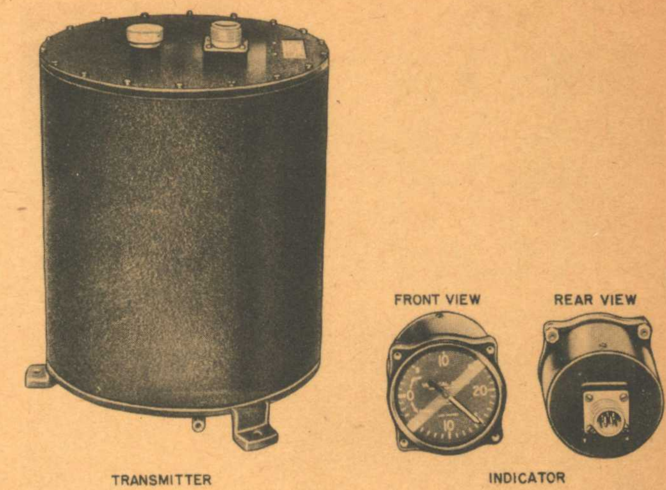


Figure 34—Vertical-Speed Indicator

d. Being one of the instruments of remote indication, the diaphragm of the transmitter is connected to the vacuum line leading from the climb-dive tank and indications of loss or gain of altitude are transmitted to the indicator on the instrument panel in the fuselage and the indicator on the operator's desk, in the same manner as indications of altitude are transmitted to the altimeter indicators.

e. The linkage between the diaphragm of the vertical-speed indicator and the transmitter telegon motor is such that only one-half the normal reduction in atmospheric pressure is required for the vertical-speed indicator to indicate a specific rate of change of altitude. In other words, the indications of the vertical-speed indicator have been synchronized with the indications of the altimeter.

25. MANIFOLD PRESSURE INDICATOR.

(*See figure* 35.)

a. The manifold pressure indicator is a special trainer instrument with a vacuum actuated diaphragm on which is mounted a delicate mechanism that moves a pointer around the dial.

b. An increase in vacuum (decrease of air pressure) causes a higher reading on the dial.

c. The arrangement of the manifold pressure indicator regulator bellows and connecting linkages is such that throttle setting and/or trainer attitude cause the proper vacuum pressure to be applied to give the desired reading on the indicator.

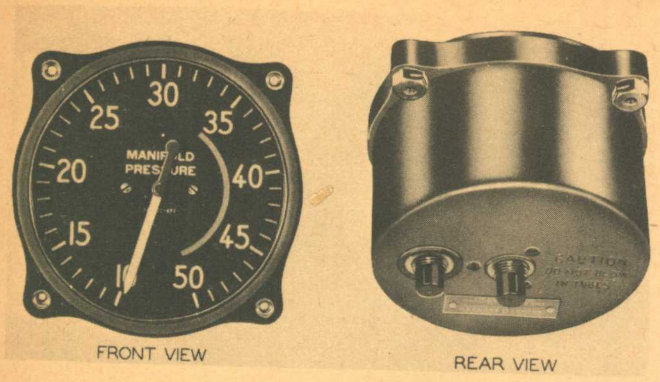


Figure 35—Manifold Pressure Indicator

d. To permit the free return of atmosphere to the manifold pressure indicator line, and return the indicator to zero, a bleed hole, protected from dust and dirt by an air filter, is cut into the line. A capillary tube or restriction in the line at the point of connection to the instrument smooths the action.

Note

On trainers manufactured prior to Link Serial No. 8454, a tachometer was used instead of the manifold pressure indicator. Except for the dial, the regulator bellows spring adjustment and the connection of the throttle link rod to the walking beam on the pitch action shaft, the instruments are identical in operation, installation, and adjustment.

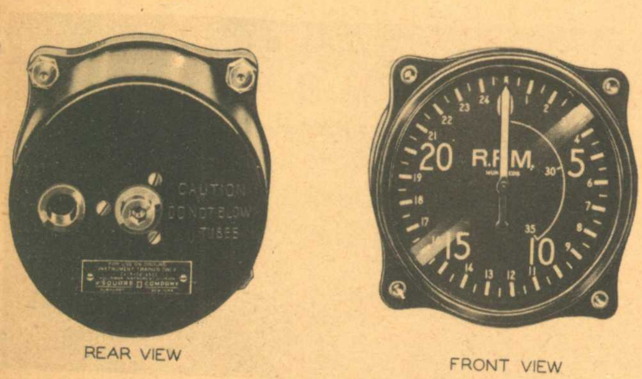


Figure 36—Tachometer

26. TURN AND BANK INDICATOR.

(*See figure* 37.)

a. This is a precision instrument used in the trainer to indicate yawing or turning motion when on instrument flight. Specific uses for the instrument are:

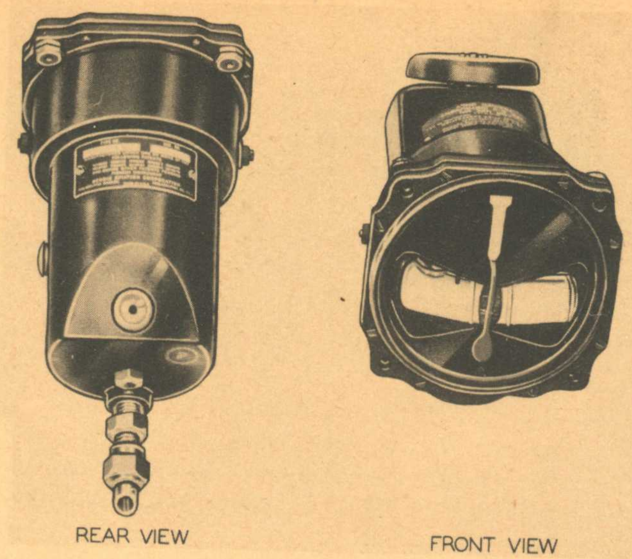


Figure 37—Turn and Bank Indicator

(1) To maintain straight and level flight.

(2) To make precision turns at predetermined rates.

(3) To properly coordinate rudder and ailerons when making turns.

b. The turn and bank indicator is a combination of two instruments—the turn indicator and the bank indicator.

c. The turn indicator unit is gyro operated and indicates by means of an indicating hand on the face of the instrument, the rate of turn about the vertical axis of the trainer.

d. The bank indicator unit, or inclinometer, is a simple pendulum device, comprising a black glass ball which moves against the damping action of a liquid in a curved glass tube in such a manner as to indicate motion about the longitudinal axis.

e. The bank indicator unit indicates that the attitude of the trainer is or is not level laterally, or indicates that the proper bank is or is not being maintained for the turns being made. It does not indicate the amount of bank.

f. The instrument differs from the standard aircraft instrument in respect to the bank indicating feature which, due to lack of centrifugal force in the trainer, is linked to the gimbal ring of the gyro.

g. A filter is connected to the instrument to prevent dust or dirt from getting into the case.

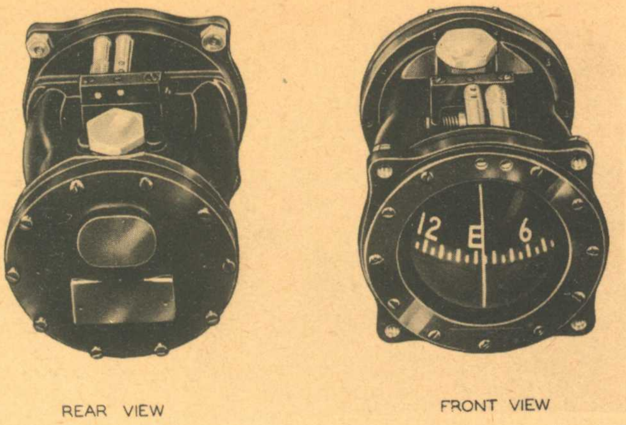


Figure 38—Magnetic Compass

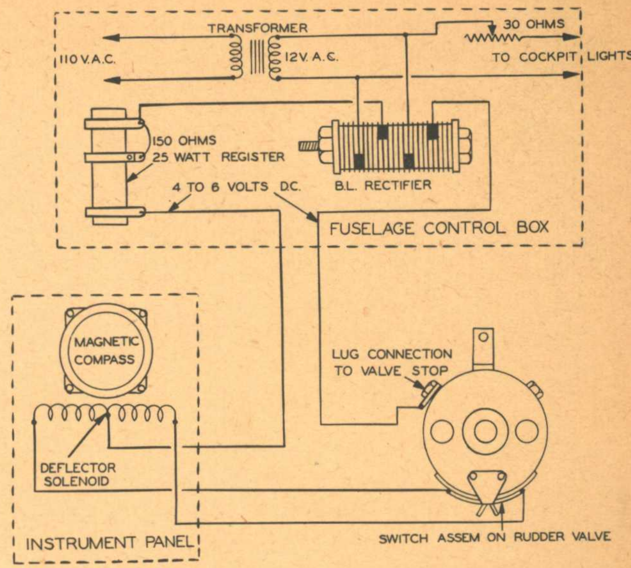


Figure 39—Compass Deflector, Wiring Diagram

27. MAGNETIC COMPASS.

(*See figure* 38.)

a. The magnetic compass is a standard aircraft instrument. It consists essentially of a non-ferrous metal bowl filled with liquid and containing a card element carrying a system of magnetized needles so suspended on a pivot that it is free to align itself with the lines of force of the earth's magnetic field. The indications on the card and the reference line (or lubber's line) are visible through the glass face of the instrument.

b. It is subjected to the same magnetic influences in the trainer as it would be in an airplane except that, due to the fact that centrifugal force is lacking in the trainer, it is necessary to simulate northerly turning error.

c. Northerly turning error is reproduced in the trainer by means of the compass deflector (figure 39) which is a solenoid, or magnet, the directional effect of which is controlled by two adjustable electrical contacts on the rudder valve.

28. SIMULATED DIRECTIONAL GYRO.

(*See figure* 40.)

a. The simulated directional gyro is used in Link instrument flying trainers only.

b. The indications of the simulated directional gyro are derived through a flexible shaft connected to a mechanical drive in the base of the trainer.

c. The primary purpose of the simulated directional gyro is to provide a fixed reference in the trainer for maintaining flight direction. Other specific uses are:

(1) To supplement the magnetic compass.

(2) To indicate magnitude or amount of turn.

(3) To aid in compensating the magnetic compass.

(4) To aid in maintaining course when making instrument approaches and landings.

d. The complete unit consists of the indicator, located on the instrument panel, the gear and drive take-off mounted on the bearing housing in the base, and the flexible shaft connecting the drive and indicator.

e. Precessional error is simulated in this instrument and can be manually controlled from no error up to one degree per minute.

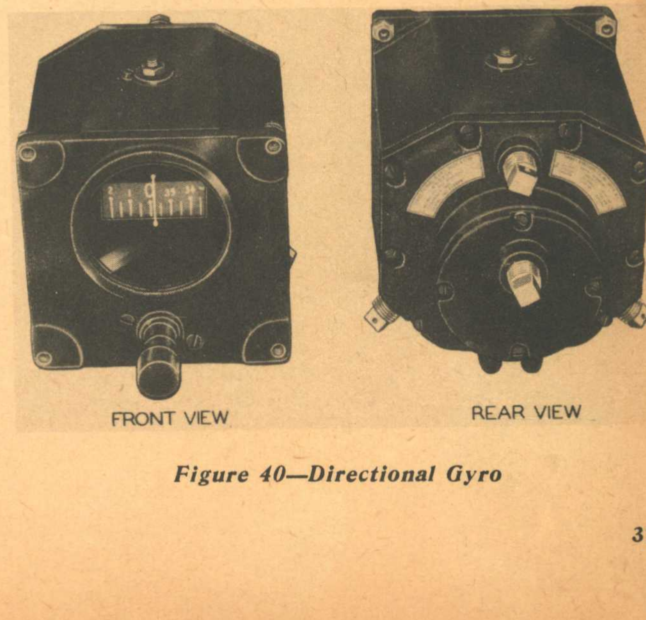


Figure 40—Directional Gyro

f. For further information, refer to AN 28-5A-1, Handbook of Instructions with Parts Catalog for the Simulated Directional Gyro (Link).

Note

The Sperry Directional Gyro was standard equipment on all instrument trainers prior to Link Serial No. 7714. For information regarding the Sperry Directional Gyro, refer to T.O. No. 05-20-10, Handbook of Instructions with Parts Catalog, Directional Gyro Indicator (Sperry).

29. ARTIFICIAL HORIZON.

(*See figure* 41.)

a. This is a simulated artificial horizon operated by pendulums instead of by a gyroscope. It provides horizon indications in the trainer similar to indications obtained from the regular instrument in flight.

b. This is accomplished by means of a horizon bar actuated laterally by one pendulum and longitudinally by another pendulum. In reading the instrument, the position of this horizon bar is compared with a miniature airplane mounted on the face of the instrument.

c. Link artificial horizon, Part No. 9570, is installed in instrument flying trainers, AN-2550-1, Link Serial Nos. 4395 to 5563, inclusive. Effective with instrument flying trainer, Link Serial No. 5564, the new artificial horizon, Part No. 11847, is installed. This newer type artificial horizon provides a greater degree of bank and is more sensitive in operation, thereby simulating to a greater degree the artificial horizon indications received in actual flight. For further information, refer to AN 28-5-4, Handbook of Instructions with Parts Catalog, Artificial Horizon Indicator (Link).

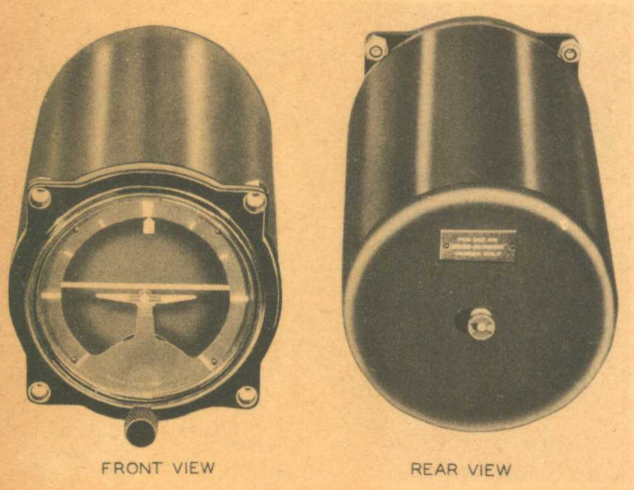


Figure 41—Artificial Horizon

30. FUEL GAGE.

(*See figure* 42.)

a. The fuel gage is operated by a clockwork mechanism. It requires approximately one hour to run down after being wound up with a key to its full capacity of 50 gallons.

b. When the pointer has run down to the zero mark, a switch is automatically opened. This switch is wired in series with the trainer main switch, so that when the gage reads zero (empty) the trainer is automatically turned off.

c. A key switch is provided, just below the ignition switch, which is wired to bridge the fuel gage switch. When this key switch is closed, the fuel gage switch has no effect on trainer operation.

d. The key with which the fuel gage is wound up and the switch key are ordinarily retained by the operator. The unit can be wound up to the desired number of gallons according to the particular problem to be run.

31. FLAP CONTROL, LANDING GEAR, AND PROPELLER PITCH CONTROL DEVICE.

(*See figure* 43.)

a. The purpose of this device is to accustom the student in the trainer to the routine operations of raising or lowering the flaps and wheels and setting propeller pitch. The complete unit consists of the following:

(1) There is a control box mounted on the inside of the hood on the trainer cockpit directly

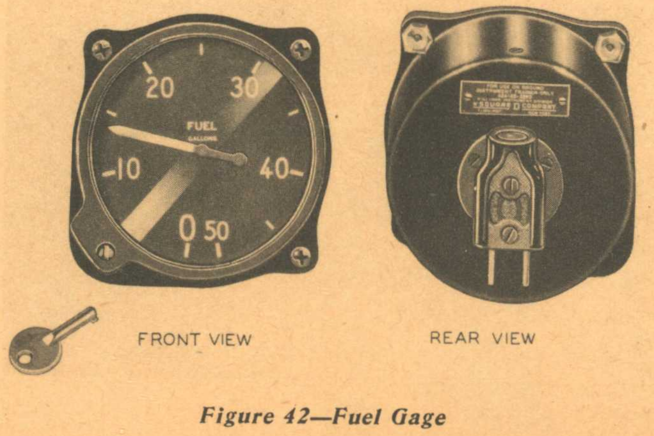


Figure 42—Fuel Gage

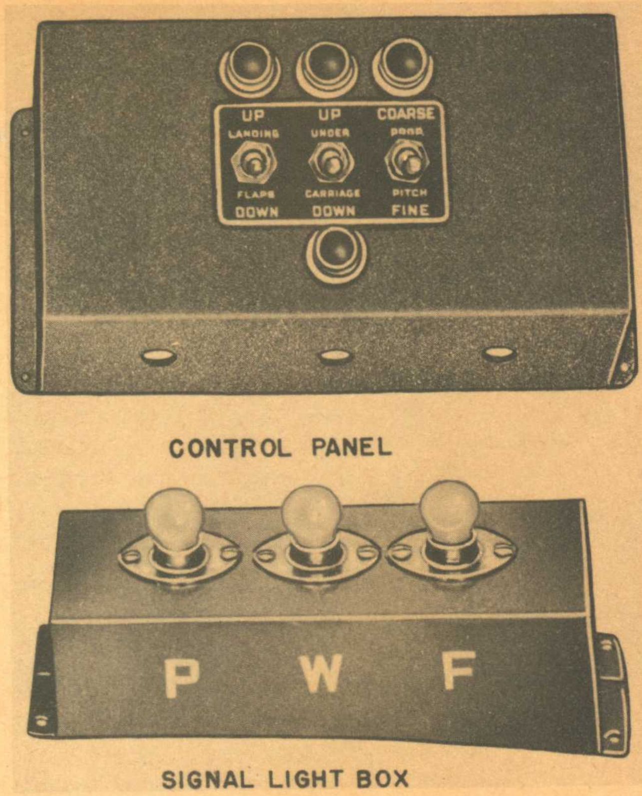


Figure 43—Flap Control, Landing Gear, and Propeller Pitch Control Device

above the instrument panel, and mounted on the panel of the control box are the following switches:

(*a*) "LANDING FLAPS"

(*b*) "UNDER CARRIAGE"

(*c*) "PROPELLER PITCH"

(2) On the face of the control box panel a small green indicator light is mounted directly over each switch, while a small red warning light is mounted directly below the middle, or landing gear, switch.

(3) To complete the unit, a signal light box containing three lights is mounted outside of the trainer cockpit on top of the hood. These signal lights are connected to and operated by the three switches on the indicator control box panel.

b. Turning the flap control switch to the "DOWN" position, lights up the green indicator light in the trainer cockpit and the flap control signal light on top of the hood, both these lights being out when the switch is in the "UP" position. In the trainer, as in an airplane, the flaps should be in the "DOWN" position only when making landings. Thus, there is always a visual indication both to the student in the trainer and the operator at the desk as to the position of the flaps and the operator is provided with a means of checking the student with regard to this routine.

c. The landing gear warning light and landing gear control switch on the indicator control panel are electrically connected to the throttle in such a manner that, if the throttle is closed beyond a certain point when the control switch is in the "UP" position, the red warning light and a loud buzzer signal are automatically turned on. These signals indicate to the student that he should have thrown the landing gear control switch to the "DOWN" position. Doing this turns off the buzzer and warning light and turns on the green signal light in the cockpit and the signal light on the top of the hood. Thus there is always a visual indication, both to the student and the operator, as to the position of the landing gear. The student is given a visual and audible warning to lower the landing gear when coming in for a landing and the operator is provided with a means of instructing and checking the student as to the established procedure.

d. The propeller pitch control is similar in operation to the flap control. The control switch on the indicator control panel should be set at "FINE" during landings and take-offs and at "COARSE" when the trainer is at cruising speed. The propeller pitch signal lights in the cockpit and on top of the hood are turned on during the time the control switch is at "FINE" and turned off during the time the control switch is at "COARSE." Visual indication as to propeller pitch is, therefore, always available both to the student and to the operator.

32. SHUT-OFF VALVES AND DE-ICER EQUIPMENT.

(*See figure* 77.)

a. ICE VALVE AND DE-ICER EQUIPMENT.

(1) This valve, located under the lower right rear of the trainer fuselage, enables the operator to shut off the vacuum line to the air-speed indicator, stopping the indications on this instrument, and thus simulating icing of the pitot head.

(2) A switch on the instrument panel simulates the pitot heater, insofar as the student is concerned. Actually, it turns on a neon light located under the right rear longéron near the icing valve. This light informs the operator that the student has observed the icing condition and has turned on the pitot heater.

b. SHUT-OFF VALVES FOR DIRECTIONAL GYRO AND TURN AND BANK INDICATOR.
(*See figure* 44.)

(1) Plain shut-off type valves are located in the vacuum lines leading to the directional gyro and turn and bank indicator. The shut-off controls for these valves are located outside the fuselage on the right-hand side and when the trainer is in operation are accessible only to the operator.

(2) When the shut-off controls are pulled out by the operator, the ports in the shut-off valves are closed, thereby cutting off vacuum to the directional gyro and the turn and bank indicator, simulating the effect of freezing or defective operation of these instruments.

(3) These shut-off valves may be operated individually or simultaneously, with or without the student's knowledge.

(4) The Link simulated directional gyro is standard equipment on currently produced instrument flying trainers. The shut-off control for this instrument is located in the front of the octagon and is operated by pulling outward on the link rod.

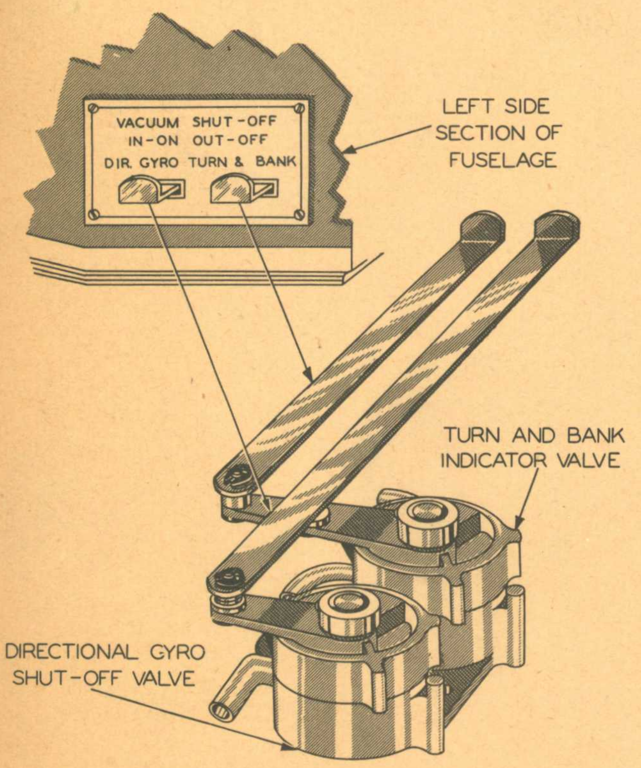


Figure 44—Shut-Off Valves for Directional Gyro and Turn and Bank Indicator

33. AUTOMATIC RECORDER.
(*See figures* 7 *and* 45.)

a. The automatic recorder travels over the chart or map on three wheels. Two of these wheels are drivers and the third is an inking wheel which leaves an inked track on the chart. Two synchronous telechron motors are geared to the driving wheels and provide forward travel of the recorder. (*See figure* 114.)

b. Directional control is obtained with a teletorque (Selsyn type) motor, located in the center of the recorder. Each of the three wheels is attached to a vertical shaft. At the top of each shaft is a large (heading) gear. All three of these large gears mesh with the small pinion gear on the teletorque motor. Thus when the teletorque motor is caused to rotate, the three large gears and their shafts also rotate and steer all three wheels. It will be seen from this that the three wheels should always be headed in the same direction.

c. A similar teletorque motor, controlled through the wind drift mechanism, is located in the trainer base and geared to the main spindle of the trainer. It is a characteristic of the teletorque motor that when the one in the base is rotated (by turning motion of the trainer), the teletorque in the recorder duplicates the turn. This steers the recorder and causes it to faithfully trace on the chart the turns made by the student in the trainer. (See figure 47.)

d. When the trainer main switch is turned on, the teletorque motors automatically line up with each

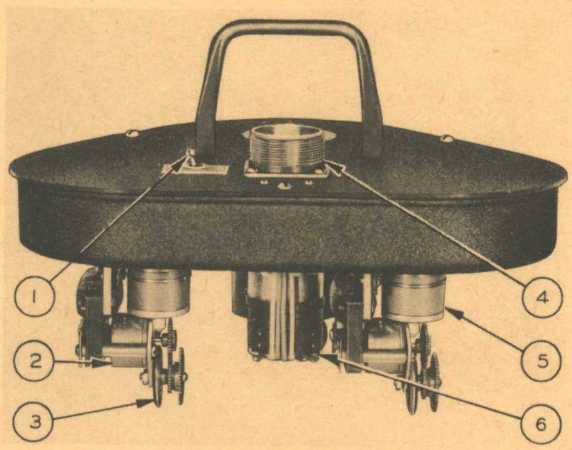


Figure 45—Automatic Recorder

1. ***Switch***
2. ***Synchronous Telechron Motor***
3. ***Drive Wheel***
4. ***Cable Terminal***
5. ***Collector Rings***
6. ***Directional Teletorque Motor***

other. Since the one in the base is geared to the main spindle through the wind drift mechanism and so cannot move unless the trainer is turned, the one in the automatic recorder rotates and lines itself up with the one in the base. Between the teletorque pinion gear and the large gears in the recorder there is a gear ratio of 12 to 1. Consequently, when the teletorques line up with each other, the large gears on the recorder will jump to the nearest of the 12 headings. If the recorder is properly synchronized, it will only be necessary at the start of each problem to spin the large gears around by hand until the inking wheel is headed in the same direction on the map as the trainer fuselage is headed by the compass. The trainer heading is shown by the cards on the octagon.

e. With the aid of a gear shifting device (figure 46), the drive gears of the telechron motors can be shifted from a low speed to a high speed. The low speed gears are used for ordinary instrument and radio orientation problems, while the high speed gear drive is used for instrument landing problems. To change from the high speed gearing to the low speed gearing, merely shift the large gear (2, figure 46) to engage with the smaller driving gear (1). The wheels, when in the low speed position, drive the recorder at .8 inches per minute at cruising speed. To change back to high speed, merely shift the gear by pulling the large driving gear away from the bracket (3) to engage the other set of driving gears. With the gear as shown in figure 46, the recorder travels 3.2 inches per minute (four times the slow speed).

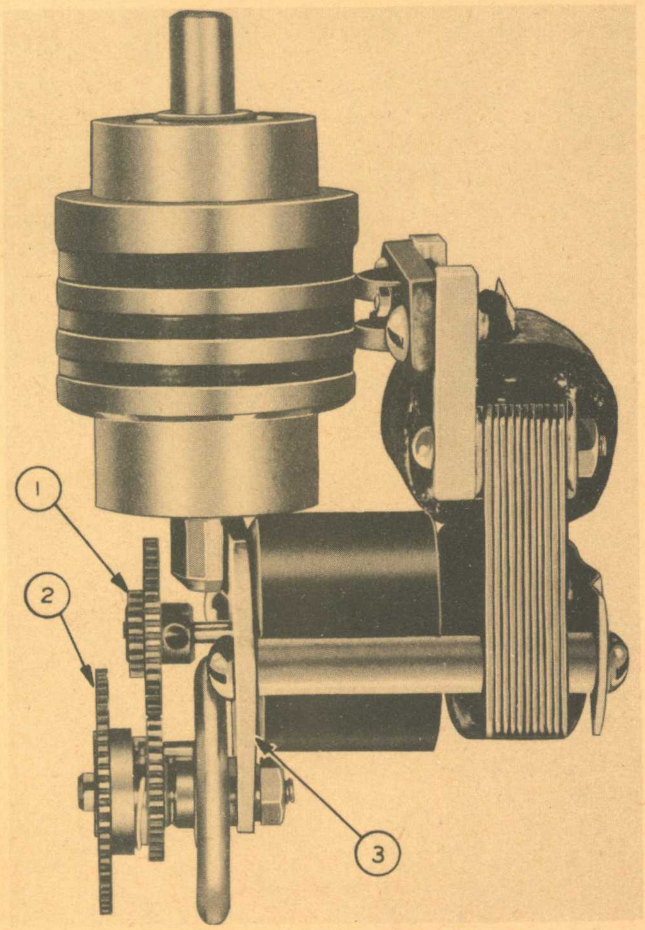


Figure 46—Gear Shifting Device (in High Speed)

1. Low Speed Gear
2. High Speed Gear
3. Bracket

34. WIND DRIFT MECHANISM.
(*See figure* 48.)

a. The purpose of the wind drift mechanism is to introduce the effects of various wind directions and wind speeds on trainer heading and ground speed. The mechanism may be compared to a mechanical brain which constantly and automatically solves the wind triangle.

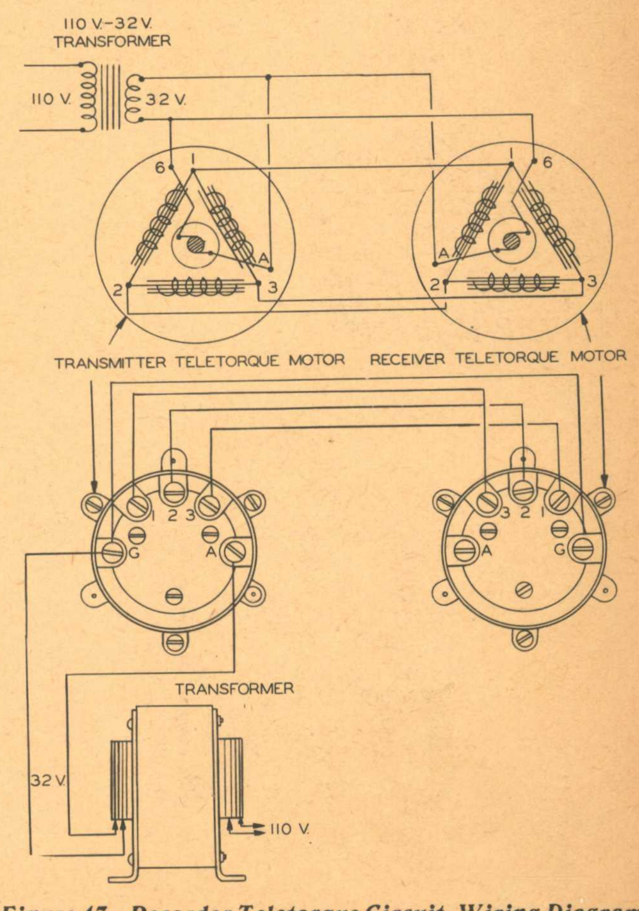


Figure 47—Recorder Teletorque Circuit, Wiring Diagram

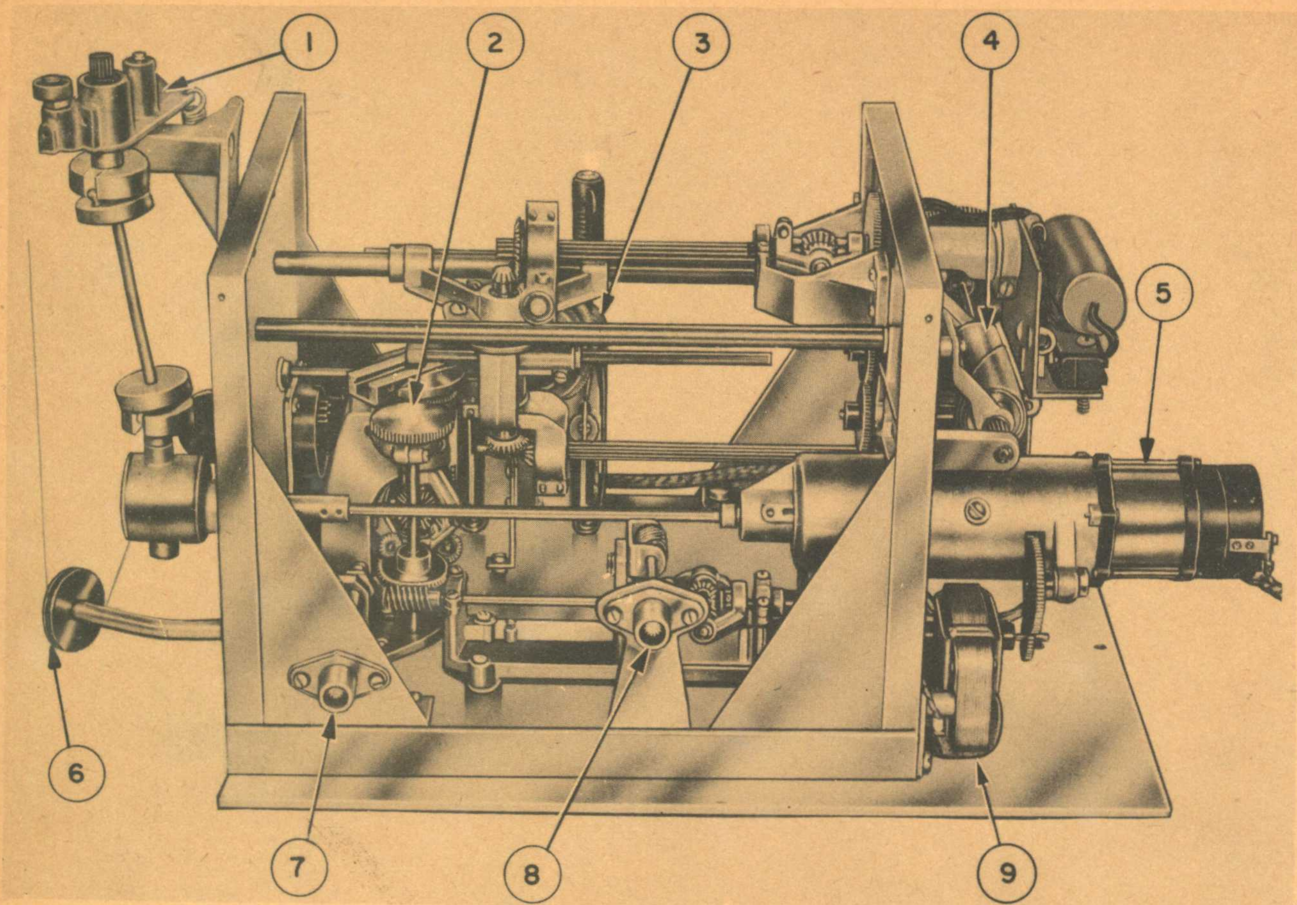


Figure 48—Wind Drift Mechanism

1. Heading Drive
2. Wind Bar
3. Air-Speed Control
4. Ground-Speed Cam
5. Track Teletorque
6. Air-Speed Cable and Pulley
7. Wind Velocity Drive
8. Wind Direction Drive
9. Anti-Backlash Motor

b. It is located in the base of the trainer and is geared to the main spindle. A wire cable running up through the spindle connects the air-speed linkage in the fuselage to the air-speed follow-up motor in the wind drift mechanism. Two dials for the introduction of wind speed and wind direction are located on the end of the operator's desk and are connected with the wind drift mechanism in the base by flexible cables.

c. The following elements are introduced into the wind drift mechanism:

(1) Heading—by rotation of the fuselage.

(2) Air speed—by throttle setting and trainer attitude.

(3) Wind direction—by the operator.

(4) Wind speed—by the operator.

d. The output of the wind drift mechanism is track (direction) and ground speed.

e. The problem of arriving at the proper track and ground speed is automatically solved by triangulation. The three sides of the wind triangle are graphically represented as follows: (See figure 49.)

(1) Heading and air speed.

(2) Wind direction and speed.

(3) Track and ground speed.

f. Each of these factors is subject to change, both in direction and length; but, in the wind drift mechanism, one of the sides of the wind triangle (air speed) remains fixed in direction and, for mechanical reasons, the wind triangle elements are arranged as follows:

(1) Air Speed—(AB)

(2) Wind Speed—(BC)

(3) Relative Wind Angle—(ABC)

g. The relative wind angle is the angle between the heading and the wind direction. From these are

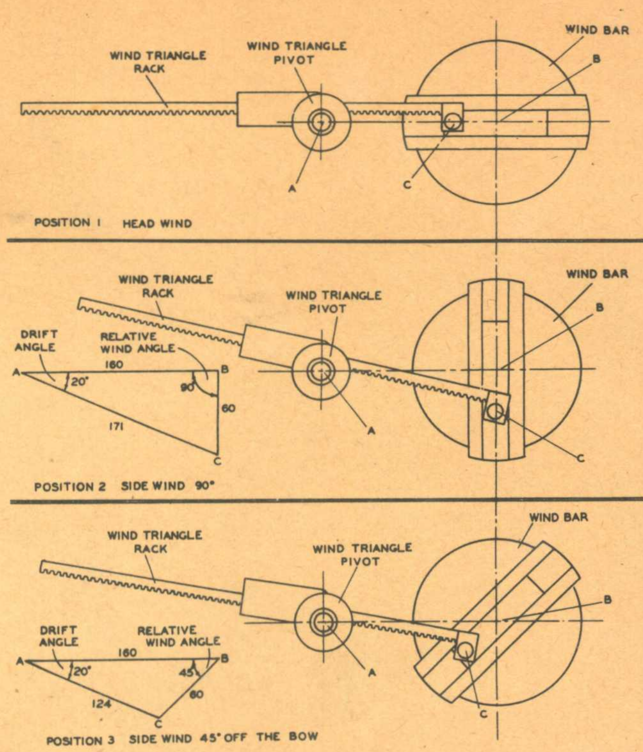


Figure 49—Wind Triangle Positions

produced the ground speed—(CA) and the drift angle (CAB).

h. To illustrate how the wind triangle in the wind drift mechanism meets the necessary conditions: an aircraft in flight on a north heading at 160 mph air speed encounters a wind from the east blowing at 60 mph. The relative wind angle is 90 degrees right. The aircraft, under these conditions, will be blown to the left at an angle of 20 degrees to the heading, that is, the drift angle will be 20 degrees left. Consequently, the track will be 360 degrees minus 20, or 340 degrees. The ground speed will be 171 mph.

i. The wind drift mechanism output consists of two movements—one represents change of track, the other change of ground speed. The movements are transmitted to the recorder by means of a teletorque unit and an intermittent motor control for the telechrons. The drive wheels are given motion by means of two telechron motors, while both drive and inking wheels are rotated by means of a teletorque in the center of the recorder.

j. To obtain variable recorder speed to simulate varying ground speed, the circuit which supplies the power (current) to the two recorder telechrons is made intermittent. The length of time the circuit remains broken or completed determines the ultimate distance that the recorder will travel in any given time. The making and breaking of the current is the function of the ground-speed drive (figure 50). A constant-speed motor is geared to a roller cam which provides intermittent breaking of the circuit for varying periods, according to the positions of the breaking mechanism as controlled by the ground-speed output.

k. Telechrons operated on an intermittent circuit have a period of overrun or coast when the circuit is broken, which is sufficient to destroy the calibration of recorder travel. It is therefore necessary to provide a brake which locks the telechron armature at the instant the 110-volt circuit is broken. This is the function of the d-c brake assembly, consisting of a 15-volt transformer, a rectifier, and a condenser. Its output, 12-18 volt dc, is applied to the telechrons when the 110-volt circuit is broken. When the small roller is on the high part of the cam roller, the ground-speed points are closed, supplying the recorder telechrons with 110-volt alternating current. When the small roller is on the low part of the cam roller the d-c brake points are closed, supplying the recorder telechrons with direct current, which instantly prevents the armature from rotating further. (See figure 50.)

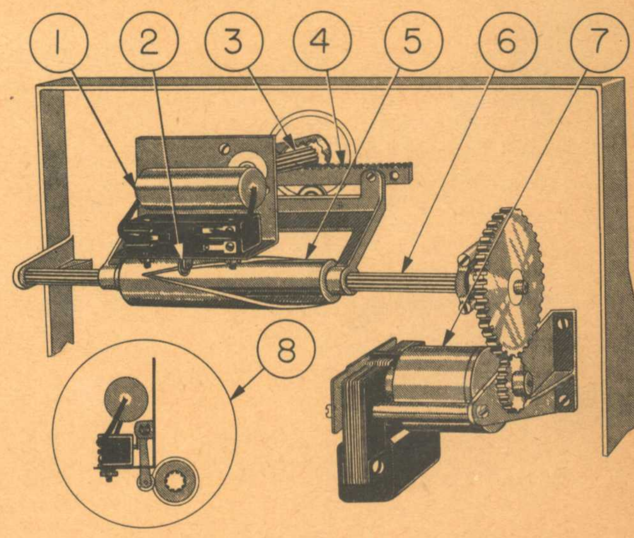


Figure 50—Ground-Speed Drive

1. *Breaker Point Assembly*
2. *Cam Follower*
3. *Ground-Speed Pinion Gear*
4. *Ground-Speed Rack*
5. *Ground-Speed Cam*
6. *Splined Shaft*
7. *Constant-Speed Motor*
8. *Detail of Cam and Follower*

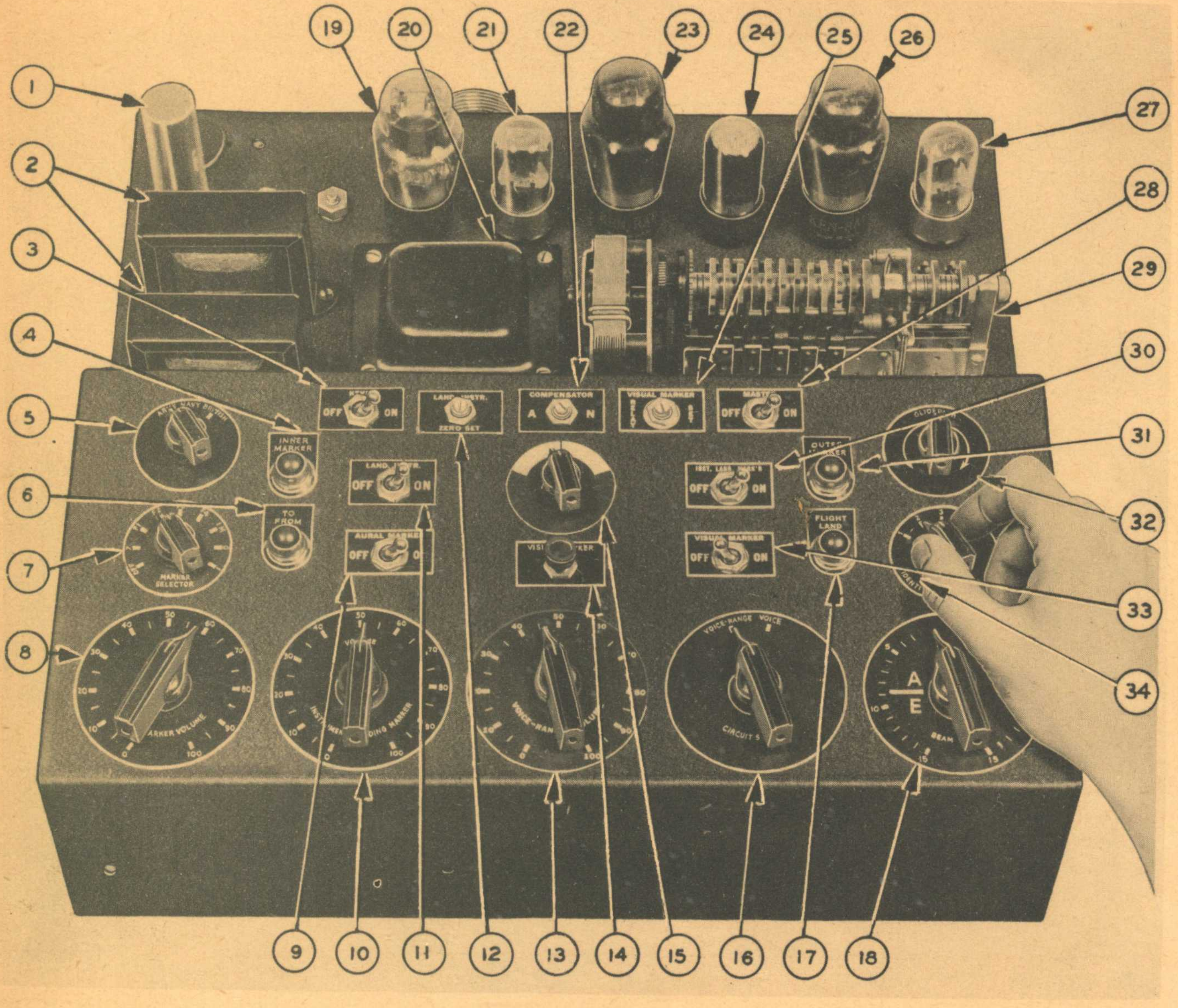


Figure 51—Radio Control Chassis

1. *Condenser*
2. *Filter Chokes*
3. *Keyer Switch*
4. *Inner Marker Light*
5. *Army-Navy-British Switch*
6. *To-From Light*
7. *Marker Selector Switch*
8. *Z Fan Marker Volume*
9. *Aural Marker Switch*
10. *Instrument Landing Volume Control*
11. *Land Instrument Switch*
12. *Land Instrument Zero Set*
13. *Voice-Range-Volume Control*
14. *Visual Marker Switch*
15. *Localizer Control*
16. *Circuit Selector Switch*
17. *Flight Land Light*
18. *Beam Shift Control*
19. *5Y3 or 5Z4 Rectifier Tube*
20. *Power Transformer*
21. *6C5 Marker Oscillator Tube*
22. *Compensator Control*
23. *6N7 Relay Amplifier Tube*
24. *6V6 Output Tube*
25. *Visual Marker Relay Set*
26. *6N7 Beam Mixer*
27. *6C5 Beam Oscillator*
28. *Master Switch*
29. *Keyer*
30. *Instrument Land Marker Switch*
31. *Outer Marker Light*
32. *Glide Path Control*
33. *Visual Marker Switch*
34. *Identification Selector Switch*

NOTE:
A,B,C,D,F, ETC. CORRESPOND TO LETTERS ON "AN" CONNECTOR.
ALL RELAY CONTACTS ARE SHOWN IN NORMAL POSITION.

SYMBOL	DESCRIPTION	PART NO.	FUNCTION
R-1	7,500 OHM 1W	12855	BIAS-VT-1
R-2	25,000 OHM 1W	6453	FILTER-VT-1
R-3	50,000 OHM POT.	6595	MARKER VOLUME CONT
R-4	80,000 OHM POT.	10036	MARKER RELAY SET
R-5	700 OHM .5W	10331	VOLTAGE DIVIDER
R-6	400 OHM 5W.W.W.	10332	BIAS-VT-2
R-7	80,000 OHM 2W	10333	VOLTAGE DIVIDER
R-8	100,000 OHM .5W	10138	GRID RESISTOR-VT-2
R-9	100,000 OHM .5W	10138	LOAD RESISTOR-VT-2
R-10	1 MEG .5W	12857	MARKER ISOLATOR
R-11	500,000 OHM .5W	12856	INST. LAND MKR. ISOLATOR
R-12	50,000 OHM POT.	6595	INST. LAND VOLUME
R-13	25,000 OHM .5W	10038	FILTER FOR VT-3
R-14	50,000 OHM .5W	10039	GRID ISOLATOR VT-3
R-15	100,000 OHM .5W	10138	VOLTAGE DIVIDER
R-16	30,000 OHM .5W	10398	VOLTAGE DIVIDER
R-17A	7,000 OHM POT.		RANGE MIXER CONTROL
R-17B	7,000 OHM POT.	6516	RANGE MIXER CONTROL
R-17C	200 OHM		FLIGHT PATH CONTROL
R-18	80,000 OHM POT.	10036	BEAM SHIFT COMPENSATOR
R-19	700 OHM .5W	10331	BIAS-VT-4
R-20	100,000 OHM .5W	10138	LOAD RESISTOR-VT-4
R-21A	250,000 OHM POT.	7781	VOICE-RANGE VOLUME
R-21B	1500 OHM POT.		FLIGHT PATH SENSITIVITY
R-22	100,000 OHM .5W	10138	VOICE-RANGE ISOLATOR
R-23	250 OHM 1W.W.W.	10041	BIAS-VT-5
R-24	50,000 OHM 10W	10152	BLEEDER RESISTOR
R-25	200 OHM POT.	5193	LAND INST. ZERO SET
R-26	200 OHM POT.	17057	LOCALIZER CONTROL
R-27	500,000 OHM .5W	12856	BIAS-VT-1
R-28	15,000 OHM .5W	6452	INST LAND PITCH CONTROL
R-29	1500 OHM 10W ADJ.	10378	PLATE VOLTAGE ADJ.
R-30	250 OHM 1W.W.W.	10041	BIAS-VT-3
R-31	25,000 OHM POT.	6716	GLIDE PATH CONTROL
R-32	3,000 OHM .5W	10136	VOLTAGE DROPPING
R-33	100 OHM 10W	11195	VOLTAGE DROPPING
R-34	100 OHM 10W	11195	VOLTAGE DROPPING
R-35	1000 OHM .5W	10137	VOLTAGE DROPPING
R-36	500 OHM .5W	11258	VOLTAGE DROPPING
C-1	.05 MFD 400V	6592	MARKER PITCH CONTROL
C-2	.2 MFD 400V	6591	CATHODE BY-PASS
C-3	.1 MFD 400V	6806	FILTER VT-1
C-4	.01 MFD 400V	6573	COUPLING COND.-VT-1
C-5	.00025 MFD	12816	COUPLING COND.-VT-2
C-6	25 MFD-25W.V.	10131	CATHODE BY-PASS
C-7	.01 MFD 400V	6573	BLOCKING COND.-VT-2
C-8	1 MFD 400V	6577	RY-3 BY-PASS
C-9	.1 MFD 400V	6806	COUPLING COND.-VT-3
C-10	.1 MFD 400V	6806	FILTER VT-3
C-11	.02 MFD 600V	12822	BEAM PITCH CONT.
C-12	.1 MFD 400V	6806	S. GRID BY-PASS
C-13	.03 MFD 600V	6450	INST. LAND. PITCH CONT.
C-14	25 MFD 25 W.V.	10131	CATHODE BY-PASS VT-4
C-15	.01 MFD 400V	6573	COUPLING COND.
C-16	50 MFD 50 W.V.	10194	MICROPHONE FILTER
C-17	25 MFD 25 W.V.	10131	CATHODE BY-PASS VT-5
C-18	15 MFD		PLATE VOLTAGE FILTER
C-19	15 MFD 450V	10148	PLATE VOLTAGE FILTER
C-20	10 MFD		PLATE VOLTAGE FILTER
C-21	50 MFD 50W.V.	10194	MICROPHONE FILTER
C-22	.2 MFD 400V	6591	CATHODE BY-PASS VT-3
C-23	.2 MFD 400V	6591	LAND. MKR. PITCH CONT.
C-24	1 MFD 400V	6577	OUTER MKR. PITCH CONT.
C-25	.1 MFD 400V	6806	INNER MKR. PITCH CONT.
C-26	.002 MFD	6575	BEAM BLOCKING COND.
C-27	.0015 MFD	7787	OUTER MKR. VOL. EQUAL
C-28	.02 MFD 600V	12822	S-3 BY-PASS
S-1	4 CIRCUIT 9 POSITION	7786	MKR. SELECTOR
S-2	1 CIRCUIT 5 POSITION	10124	IDENTIF. STATION SEL.
S-3	2 POLE 1 THROW	6581	INST. LANDING ON-OFF
S-4	2 POLE 1 THROW	6581	LANDING INST. ON-OFF
S-5	2 POLE 1 THROW	6581	MASTER ON-OFF
S-6	2 POLE 1 THROW	6581	KEYER ON-OFF
S-7	2 POLE 1 THROW	6581	VISUAL MKR. ON-OFF
S-8	PUSH BUTTON 1 CIR.	10168	MANUAL VISUAL SW.
S-9	DOUBLE KEYER CONT.		BEAM OR IDENTIF. SEL.
S-10	DOUBLE KEYER CONT.		BEAM OR IDENTIF. SEL.
S-11	DOUBLE KEYER CONT.		A-N
S-12	SINGLE KEYER CONT.		INNER & LANDING MKR.
S-13	SINGLE KEYER CONT.		FAN MKR. 1
S-14	SINGLE KEYER CONT.		FAN MKR. 2
S-15	SINGLE KEYER CONT.		FAN MKR. 3
S-16	SINGLE KEYER CONT.		FAN MKR. 4
S-17	SINGLE KEYER CONT.		IDENTIF. STATION 1
S-18	SINGLE KEYER CONT.		IDENTIF. STATION 2
S-19	SINGLE KEYER CONT.		IDENTIF. STATION 3
S-20	SINGLE KEYER CONT.		IDENTIF. STATION 4
S-21	SINGLE KEYER CONT.		IDENTIF. STATION 5
S-22	3 CIRCUIT 2 POSITION	6583	VOICE-VOICE RANGE
S-23	2 POLE 2 THROW	6722	AURAL MKR. ON-OFF
S-24	12 CIRCUIT 3 POSITION	6451	ARMY-NAVY-BRITISH
VT-1	6C5	10105	MARKER OSCILLATOR
VT-2	6N7	10092	VISUAL MKR. RELAY
VT-3	6C5	10105	BEAM OSCILLATOR
VT-4	6N7	10092	BEAM MIXER
VT-5	6V6	10013	OUTPUT
VT-6	5Z4 (5Y3GT/G)	12752	RECTIFIER
RY-1	RELAY	12751	INNER AURAL SELECTOR
RY-2	RELAY	12751	OUTER AURAL SELECTOR
RY-3	RELAY	12800	VISUAL MARKER
L-1	8 H CHOKE	10147	PLATE VOLT. FILTER
L-2	8 H CHOKE	10147	PLATE VOLT. FILTER
L-3	11 H CHOKE	6588	MICROPHONE FILTER
T-1	TRANSFORMER	10098	MARKER OSCILLATOR
T-2	TRANSFORMER	10098	RANGE OSCILLATOR
T-3	TRANSFORMER	10146	POWER
T-4	200-1 TRAN.	10114	MICROPHONE
T-5	1-1 TRAN.	10116	OUTPUT
J-1	2 CIRCUIT JACKS	6813	PHONES
J-2	2 CIRCUIT JACKS	6813	MICROPHONE
B-1	6V LAMP ASSEM.		TO-FROM IND.
B-2	6V LAMP ASSEM.	7147	FLIGHT-LAND IND.
B-3	6V LAMP ASSEM.	9365	OUTER MARKER IND.
B-4	6V LAMP ASSEM.		INNER MARKER IND.
R-37	1000 OHM .5W	10137	VOLTAGE DROPPING
R-38	10,000 OHM .5W	12867	VOLTAGE DROPPING
R-39	10,000 OHM .5W	12867	INST. CURRENT LIMITING
R-40	15,000 OHM .5W	6452	INST. CURRENT LIMITING

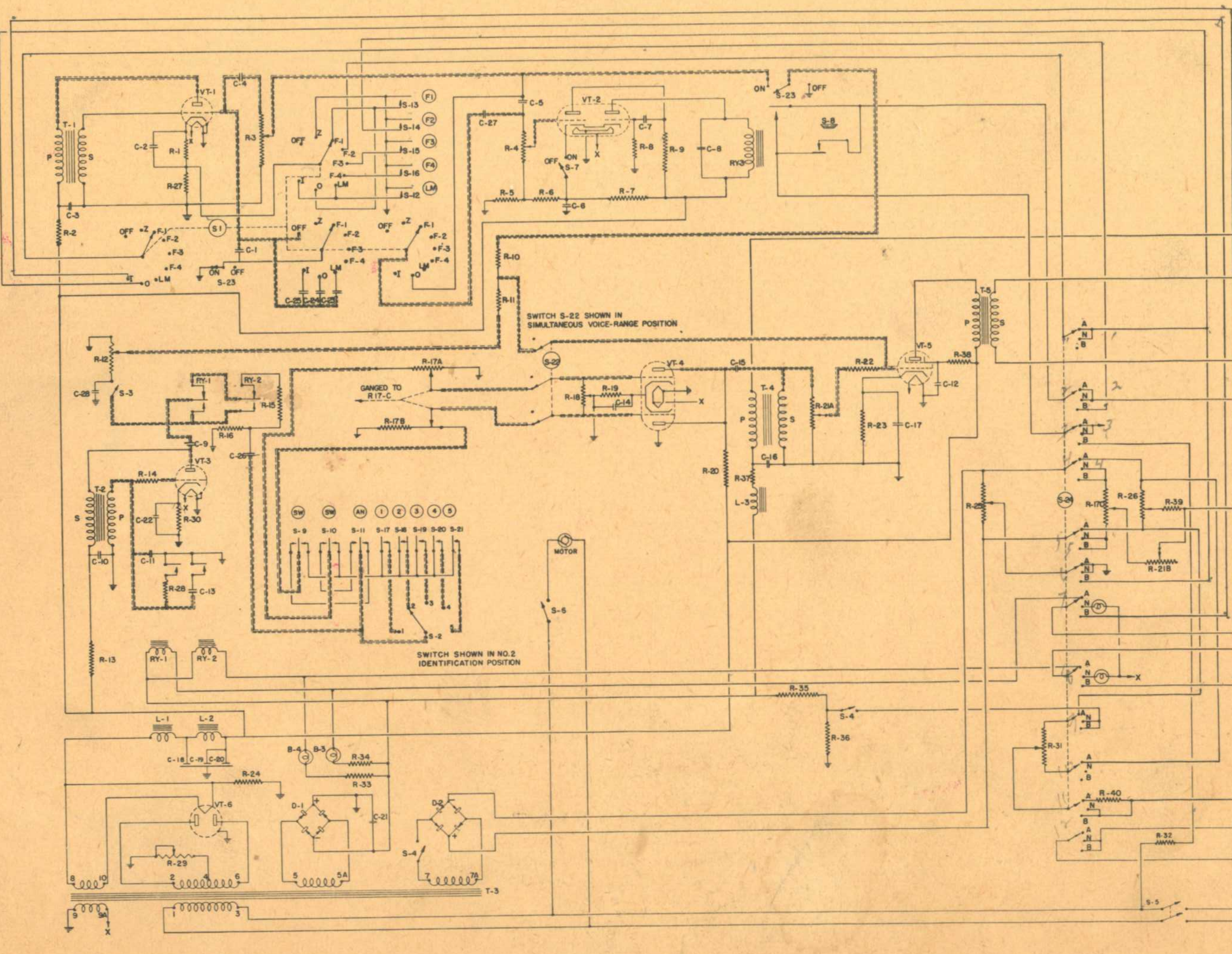


Figure 52—Radio, Wiring Diagram (Applicable only to Instrument Flying Trainers, AN-2550-1, beginning with Link Serial No. 5551)

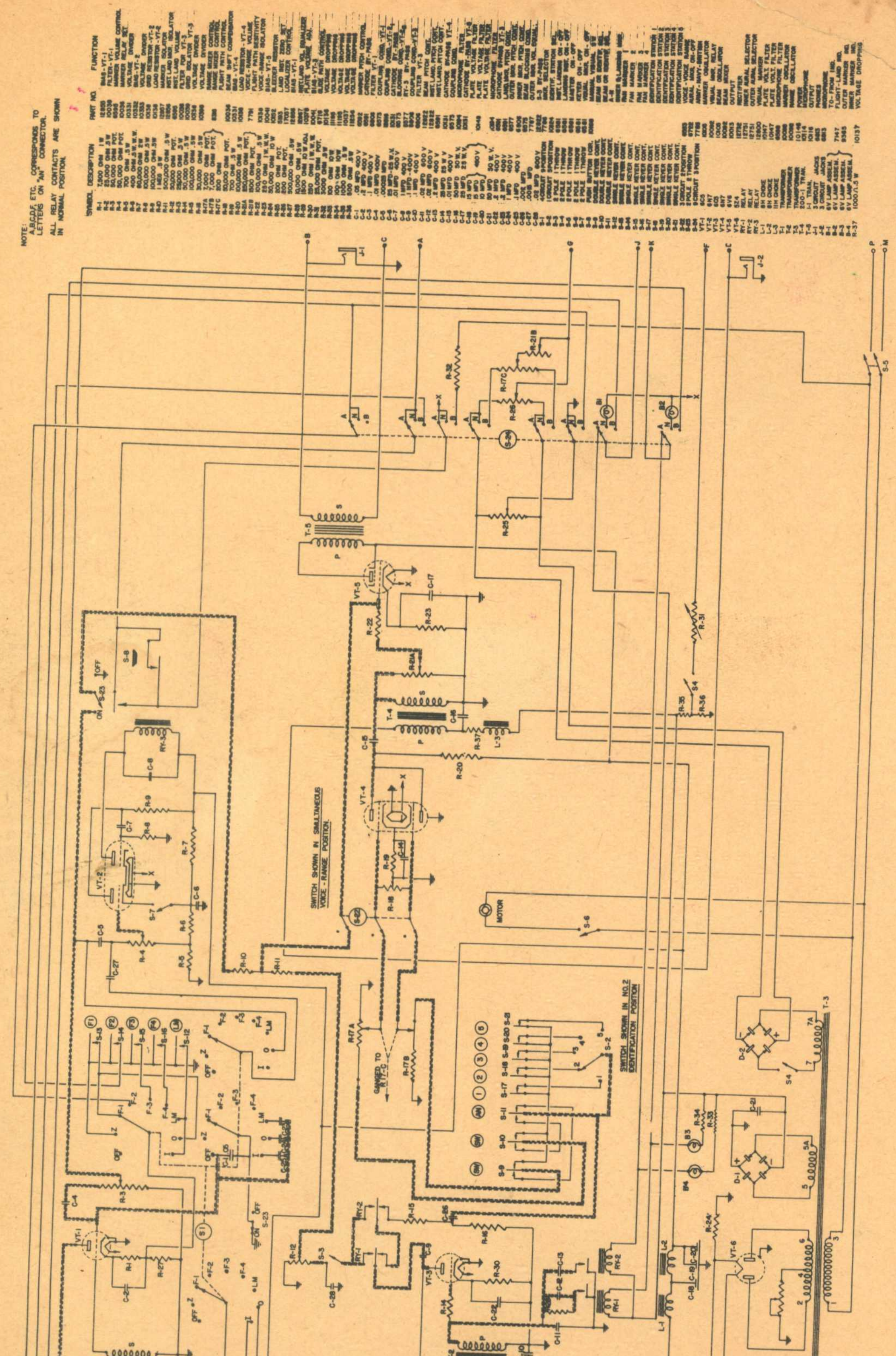


Figure 53—Radio, Wiring Diagram (Applicable to Instrument Flying Trainers, AN-2550-1, Link Serial No. 4395–5550, inclusive)

35. RADIO, INSTRUMENT LANDING SYSTEMS, AND RADIO RANGE KEYER.

(*See figures* 51 *through* 58.)

a. RADIO.

(1) The radio equipment in the trainer provides for the selection of various circuits so that range, visual and aural markers, voice and landing marker signals may be reproduced to simulate those received in actual flight. (See wiring diagrams, figures 52 and 53.)

(2) No actual radio transmission is employed. Instead, all signals between the desk and the trainer pass over wired circuits.

(3) Microphones and earphones are provided at the operator's desk and in the trainer, permitting two-way voice communication between operator and student. Provision is also made at the operator's desk for several additional pairs of earphones, so that other students may listen in while problems are being flown by a student in the trainer.

(4) The power supply section provides the necessary operating voltage for the remainder of the control chassis, the relays, microphone, and landing instruments. It is composed of the following units:

(*a*) A transformer (T-3, figures 52 and 53), having a primary and five secondary windings:

1. A rectifier filament winding.
2. A high voltage supply winding.
3. Filament supply winding.
4. Microphone supply winding.
5. A flight path instrument supply winding.

(*b*) The rectifier tube is a high vacuum full wave rectifier which feeds rectified current through a filter system composed of chokes (L1) and (L2) and capacitors (C-18), (C-19), and (C-20) (figures 52 and 53).

(*c*) A bleeder resistor (R-24) is provided across the output of the power supply section.

(*d*) A-c voltage from the microphone supply winding is applied to a dry disk rectifier (D-1) and the output current is filtered by capacitor (C-21).

(*e*) A portion of the current operates relays (RY-1), (RY-2), indicator lamps (B-3) and (B-4), and the landing path instruments.

(*f*) The remaining current is further filtered by (L-3) and (C-16), is limited by (R-37), and applied to the microphone circuit.

(*g*) A-c voltage from the flight path instrument supply winding is applied to the dry disk rectifier (D-2) and the rectified current is then applied to the flight path instrument circuits.

b. INSTRUMENT LANDING SYSTEMS.

(1) The radio also provides facilities for the selection of three types of landing systems:

(*a*) The Army Air Force system (Army Cross Pointer) using inner and outer landing trucks, automatic radio compass, visual and aural marker beacons, and an Army cross pointer indicator. (See figure 54.)

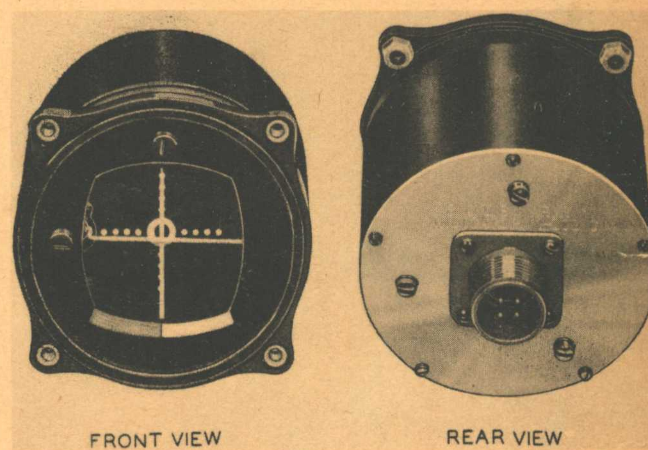


Figure 54—Army Cross Pointer Indicator

(*b*) The Navy system (Navy Cross Pointer) consisting of the Navy cross pointer landing instrument (figure 55) in conjunction with aural and visual landing markers.

(*c*) The British System (Standard Beam Approach) using the standard beam approach indicator (figure 56) with aural markers synchronized with the visual markers in the instrument.

(2) The following radio equipment is provided in the fuselage for the student:

(*a*) A radio volume control for controlling the amplitude of the radio signals in the headphone.

(*b*) A call switch for signaling to the operator's desk.

(*c*) A station selector switch for selecting inner marker range or outer marker stations.

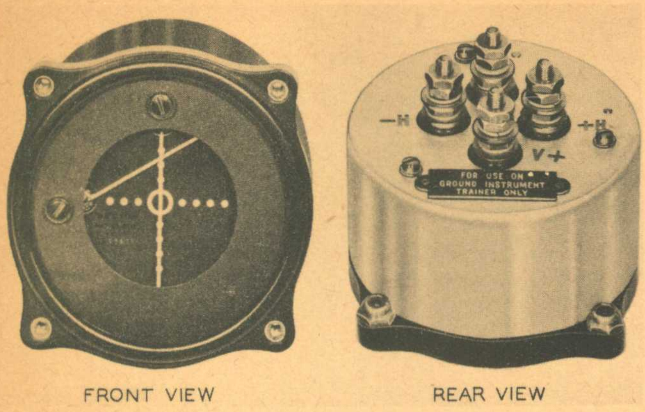


Figure 55—Navy Cross Pointer Indicator

(*d*) "TO-FROM" switch for reversing the cross pointer indication when leaving a station. In the "FROM" position this switch also closes a circuit which lights lamp (B-1) on the radio control chassis.

(*e*) In conjunction with this, and used with the Navy system, is a selector switch which turns on the landing path needle of the cross pointer and remote landing path instrument when in the "flight" position and lights the indicator lamp (B-2) on the radio control chassis when in the "land" position.

(*f*) A toggle switch is provided for turning on the standard beam approach indicator in the British system and the runway localizer in the Army system.

(*g*) A receptacle is provided in the front of the fuselage control box to receive one of three types of cable assemblies and instruments, determined by the landing system to be used. These cable assemblies are designed to automatically switch the electrical circuits of the trainer to suit the individual type of instrument being used.

(3) When changing from one type of instrument landing system to another, the proper circuits at the desk are selected by a single switch marked "ARMY–NAVY–BRITISH." The circuits in the fuselage are automatically switched when the appropriate indicator and its cable are installed.

CAUTION

Serious damage to the landing instruments may result if the switch at the desk is placed in other than its correct position for the type of indicator being used. This fact should be impressed upon operating personnel.

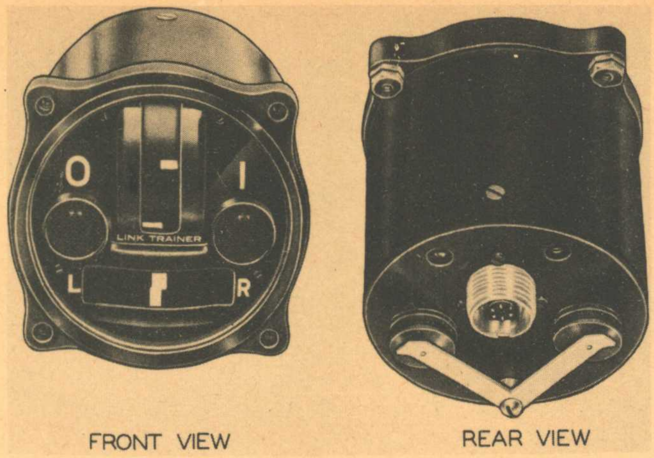


Figure 56—Standard Beam Approach Indicator

(4) In addition to the above, it is also necessary to change keyer cam assemblies. The same cam assembly serves for the Army and Navy landing systems and an additional cam assembly is provided to be installed when simulating the British system.

(5) A selector switch is provided on the control chassis for selecting any one of the three systems.

(6) Assuming that the selector switch is in the "ARMY" position, the description is as follows:

(*a*) The range oscillator utilizes a type 6C5 tube in conjunction with an oscillation transformer (T-2, figures 52 and 53). Capacitor (C-11) connected across the primary winding forms the resonant circuit, tuning the oscillator circuit to a frequency of 1020 cycles. The oscillator output signal passes through the contacts of (RY-1) and (RY-2) and is applied to a voltage divider network consisting of resistors (R-15) and (R-16). The signal then travels from the junction of these two resistors to the range keyer where it is keyed.

(*b*) The relays (RY-1) and (RY-2) are controlled by a selector switch in the fuselage control box. With this switch in the "RANGE" position neither relay is operated and the signal takes the path described above. With the selector switch in the "OUTER" position, relay (RY-1) is operated and the additional resistance of (R-28) is connected across the tuning circuit, resulting in a resonant frequency of 1100 cycles. (See figures 52 and 53.) In instrument flying trainers, AN 2550-1, Link Serial Nos. 4395 to 5550 inclusive, capacitor (C-12) was used, instead of resistor (R-28), producing a resonant frequency of 800 cycles.

(*c*) Additional contacts on (RY-1) serve to remove the signal from the junction of the voltage divider network and apply it through switch (S-3) to volume control (R-12) and then to the grid of the 6V6 amplifier tube.

(*d*) This signal simulates the outer marker beacon signal of the Air Corps instrument landing system.

(*e*) With the selector switch in the "INNER" position, relay (RY-2) is operated and relay (RY-1) is released. With (RY-2) closed the capacitor (C-13) is shunted across the tuning circuit producing a frequency of 700 cycles. The signal then reaches the 6V6 amplifier in the same manner as the 1100-cycle signal. This 700-cycle signal simulates the inner marker beacon of the instrument landing system. (See figures 52 and 53.)

(*f*) The 400-cycle frequency is used in instrument flying trainers, AN 2550-1, Link Serial Nos. 4395 to 5550 inclusive. (See figures 52 and 53.)

(*g*) Shunted across relay (RY-1) and (RY-2) are lamps (B-3) and (B-4). In series with each lamp is a resistor which limits the voltage to the lamps and simultaneously prevents the relays from closing when the selector switch in the fuselage control box is in the "RANGE" position.

(*h*) When this switch is in the "OUTER" position, relay (RY-1) closes and lamp (B-3) on the control chassis glows.

(*i*) In the same manner lamp (B-4) lights when the selector switch is in the "INNER" position.

(*j*) These lamps serve to indicate to the operator the position of the selector switch in the fuselage should the landing marker switch (S-3) be open or the volume control (R-12) be at minimum signal position on the control chassis.

(*k*) The marker beacon oscillator utilizes a type 6C5 tube in conjunction with an oscillation transformer (T-1). Capacitor (C-1) shunted across the transformer secondary forms a resonant circuit which produces a 3,000-cycle signal.

(*l*) The output of the oscillator is coupled by capacitor (C-4) to the potentiometer (R-3) which controls the amplitude of the signal. The oscillator is keyed by shorting out a high resistance (R-27) in series with the oscillator cathode bias resistor (R-1). From the slider on (R-3) a portion of the signal is applied through (S-23) and (S-22) to the grid of the 6V6 amplifier tube. The remaining portion of the signal operates the 6N7 relay tube (VT-2) in such a manner that each signal pulse closes relay (RY-3). The relay in turn closes a circuit to an indicator lamp on the instrument panel, thus giving visual indications of the marker beacon signals.

(*m*) A switch (S-7) is provided for removing visual signals if desired and a push button (S-8) enables the operator to give visual signals other than those provided automatically by the keyer.

(*n*) Returning to the range oscillator, the output of the oscillator passes through the keyer to the beam shift control (R-17a) and (R-17b) and then to the grids of the 6N7 mixer tube (VT-4). The output of this tube is coupled by capacitor (C-15) to the voice-range volume control (R-21).

(*o*) The secondary winding of the microphone transformer is also connected across (R-21), the combined voice and range signals being applied to the grid of the 6V6 amplifier tube. The output signals of the 6V6 amplifier are transformer-coupled to the headphones in the desk and in the fuselage.

(*p*) D-c voltage from rectifier (D-2) is applied to potentiometers (R-25), (R-26), and (R-31). (See figures 52 and 53.)

(*q*) In instrument flying trainers, AN 2550-1, beginning with Link Serial No. 5551, the slider of (R-25) is grounded and the slider of (R-26) connects to the vertical terminal of the remote Army cross pointer indicator, through resistor (R-39), while the slider of (R-31) connects to the horizontal terminal of the Army cross pointer indicator through resistor (R-40). The vertical elements of the cross pointer indicators are wired in series and are, therefore, always synchronized, as also are the horizontal elements, and with the same result. With the slider of (R-25) set at the mid-position, any subsequent movement of the potentiometer (R-26) will deflect the vertical pointers of the indicators. Likewise, any movement of the control knob (R-31) will deflect the horizontal pointers of the indicators. (See figures 52 and 53.)

(*r*) In instrument flying trainers, AN 2550-1, Link Serial Nos. 4395 to 5550, inclusive, d-c voltage from rectifier (D-2) is applied to potentiometers (R-25) and (R-26). The slider of (R-25) is grounded and the slider of (R-26) is connected to one terminal of the runway localizer indicator, the other terminal being grounded. With the slider of (R-25) set at the mid-position, any subsequent movement of

potentiometer (R-26) will deflect the runway localizer indicator. (See figures 52 and 53.)

(7) With the switch (S-24) in the "NAVY" position and with a Navy cross pointer indicator substituted for the Army landing instrument, the Navy instrument landing system may be simulated.

(*a*) The range oscillator circuit remains as in the "ARMY" system with the exception that relays (RY-1) and (RY-2) are inoperative and the oscillator output remains connected to the keyer through condenser (C-26) at all times.

(*b*) An additional marker frequency is available in the "NAVY" position and is known as the Navy landing marker.

(*c*) An additional condenser (C-23) is switched into the circuit switch (S-1), this condenser serving to tune the marker oscillator to a frequency of 1300 cycles. At the same time the oscillator is keyed by contact (S-12) on the keyer.

(*d*) Indicator lamps (B-1) and (B-2) serve to indicate to the operator the position of the instrument landing switches in the fuselage.

(*e*) Potentiometer (R-26) controls the vertical pointer deflection of the Navy cross pointer indicator, while (R-31), now connected as a rheostat, due to the changed position of the A-N-B switch, controls the horizontal pointer and the glide path indicator at the desk. (See figures 52 and 53.) Potentiometer (R-17C) is used in trainers beginning with Link Serial No. 5551.

(8) With switch (S-24) in the "BRITISH" position and a standard beam approach indicator installed in the instrument panel, the British landing system may be simulated.

(*a*) The range oscillator circuit remains as before but in this case the signal is keyed to provide the E-T interlock signals.

(*b*) Potentiometer (R-17c) replaces (R-26) in the circuit, the slider being connected through series rheostat (R-21b) to the horizontal element of the standard beam approach indicator. Since (R-17c) is on a common shaft with beam shift control (R-17a) and (R-17b), the indicator is deflected to the right or left in accordance with the position of the beam shift control.

(*c*) The slider on (R-25) is grounded indirectly through keyer contact (S-14) producing an intermittent deflection or "kick" rather than continuous deflection. Rheostat (R-21b) controls the amount of deflection and is on a common shaft with potentiometer (R-21a). Potentiometer (R-21a) controls the volume of the voice and range signals.

(*d*) The marker oscillator frequency is determined by the setting of switch (S-1) which adds additional capacity to the tuned circuit to produce frequencies of 700 and 1700 cycles to simulate the standard beam approach inner and outer markers.

(*e*) The marker oscillator is keyed at the proper rate by keyer contacts (S-12) and (S-13).

(*f*) Another section of switch (S-1) selects either the inner or outer marker lamp on the standard beam approach indicator, the respective lamp being keyed in unison with the aural signal through relay (RY-3).

(*g*) Condenser (C-27) is shunted across condenser (C-5) in the outer marker switch position to equalize the signal voltage applied to the relay tube (VT-2) at the 700-cycle marker frequency.

(*h*) The vertical moving element of the flight path indicator and the landing path indicator are controlled by rheostat (R-31).

(*i*) Switch (S-4) serves as an "ON-OFF" switch for the landing instruments.

c. RADIO RANGE KEYER.
(*See figures* 57 *and* 58.)

(1) The purpose of the keyer is to take a steady tone which is produced by the trainer radio and break it up into A's and N's or E's and T's, station identification letters, and marker signals.

(2) The steady note, or signal, is given a choice of routes from inside the control chassis to the keyer and back again into the control chassis. This signal is made to produce A's and N's or E's and T's when routed one way, and identification letters when switched through the other routes.

(3) A's and N's are produced by one cam and three contacts. Two of the contacts are fixed and the middle one is actuated by the cam. The high parts of the cam press the movable contact against the outer of the two fixed contacts and produce A's, while the low parts of the cam produce N's in the same manner, from the inner fixed contact. The points are so adjusted that the movable contact is making connection at all times either with the outer or with the inner fixed contact. Thus the dit of the A fills the space between the dah and dit of the N. Therefore, when the signals produced by both sets

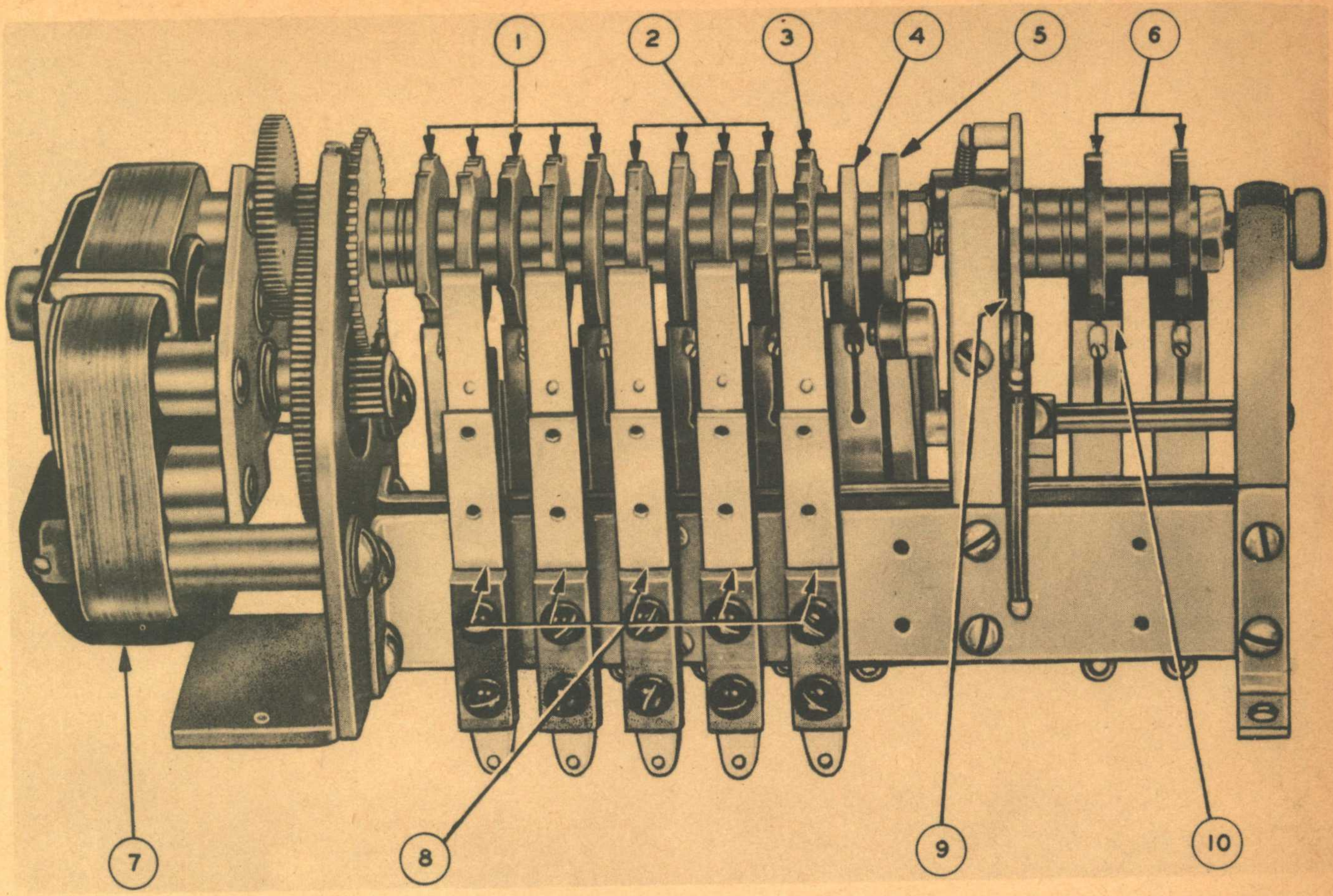


Figure 57—Radio Range Keyer

1. *Station Identification Cams*
2. *Fan Marker Cams*
3. *Navy Landing Marker Cam*
4. *A-N Cam*
5. *Ratchet Cam*
6. *Switching Cam*
7. *Constant-Speed Drive Motor*
8. *Cam Contacts*
9. *Ratchet*
10. *Switching Cam Contacts*

of contacts are heard with equal intensity, a continuous monotone results.

(4) The current for the A's and N's leaves the beam oscillator circuit of the radio chassis on a wire which connects to the middle (movable) contact of the A-N cam. This cam presses the movable contact alternately against the two fixed contacts in such a manner as to produce A's and N's. These contacts are adjusted so that the moving one makes contact with one of the fixed points at the same instant it breaks contact with the other. Thus there is no overlap, yet current is flowing continuously through either one or the other.

(5) From the A-N keyer contacts the current travels back to the A-N mixture control where the A's and N's are blended into various radio range characters.

(6) The A-N cam is in operation for 30 seconds and then it is interrupted electrically while two sets of station identification letters are sent.

(7) This is accomplished by the switching cam assembly on the right-hand end of the keyer. Two cams and two sets of contacts are provided on this assembly, driven by a ratchet and ratchet cam assembly, which advances one notch with each revolution of the main cam assembly. These sets of contacts interrupt the A and N current supply and switch the current through the station identification cam contacts instead of through the A-N contacts.

(8) During the thirty seconds of the A's and N's, these points are closed, as in position (A, figure 58). At the end of the 30-second period, both contacts are opened, thus interrupting the current

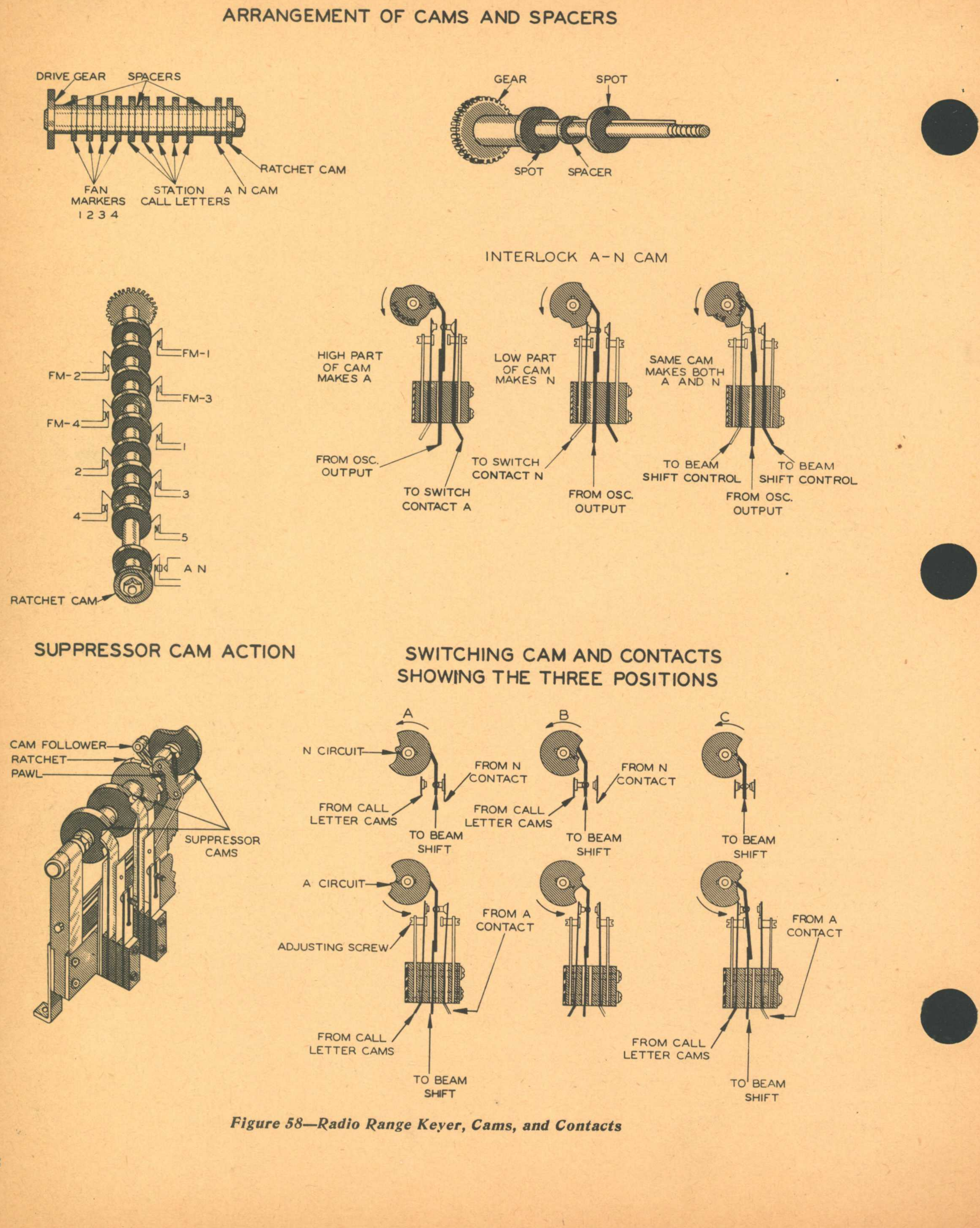


Figure 58—Radio Range Keyer, Cams, and Contacts

to the A-N cam contacts. At the same time the contact in the N circuit of the switching cam contacts is permitted to move far enough to make contact with the fixed contact position (B, figure 58), which is connected to the common wire connecting the station identification cam contacts during one revolution of the main cam assembly. The station identification is thus transmitted to the N side of the mixture control.

(9) The ratchet then advances the switching cams another notch, which allows the movable contact on the A circuit, as in position (C), to make contact during the next revolution of the main cam assembly. The station identification call is repeated and transmitted through the A side of the mixture control.

(10) With the next notch moved by the ratchet the cams push the contacts back to their original position, making the circuit complete again on the A-N cam contacts.

(11) Five different station identification calls are provided. The same tone used for A-N signals is used for station call letters but is handled differently. Through a selector switch located on the control chassis, any one of the five stations may be selected.

(12) By replacing the main cam assembly with a "BRITISH" cam assembly, E's and T's are produced in the same manner as A's and N's.

(13) Station identification calls are omitted in the "BRITISH" system.

(14) Keying of the fan marker is arrived at differently than in the method of keying A's and N's and station identification calls. Instead of keying the oscillator output, the keyer contacts close the circuit of a high resistance (R-27, figures 52 and 53) to ground, which starts the oscillation of the marker circuit. This manner of keying eliminates the undesirable key clicks of the fan marker contacts.

(15) The fan marker cams are cut differently for proper coding of radio signals.

(16) Signals for the landing markers, the four fan markers, and the Z marker are obtained by the positioning of the nine-position selector switch.

(17) When the selector switch is in the "Z MARKER" position the circuit is continuously closed and the high resistance (R-27, figures 52 and 53) circuit is shorting to ground, allowing oscillation to take place in the marker oscillator tube as long as the switch is closed.

(18) The main output leads for all circuits, including mixture control and keyer A-N circuits, are shielded to prevent induction of signal and insure minimum interference between the various circuits.

36. AUTOMATIC RADIO COMPASS.

(*See figures* 5, 47, *and* 82.)

Four teletorque motors form the basis of the automatic radio compass system, as follows:

a. One transmitter teletorque motor is located in the control unit at the operator's desk and is provided with a suitable vernier drive and azimuth scale. (See figure 82.) Rotation of the knob of the control unit rotates and positions the armature of a receiver teletorque motor (the lower of the two teletorque motors in the trainer base). (See figure 5.)

b. The armature of the receiver (lower) teletorque motor in the base is coupled mechanically with the armature of the upper teletorque motor, the latter being used as another transmitter.

c. The shell of the upper teletorque motor in the base engages a gear which meshes with the spindle gear and rotates as the trainer is rotated. The field coils of the (upper) transmitter teletorque motor are connected to the field coils of the fourth teletorque motor (receiver) located in the radio compass indicator on the trainer instrument panel.

d. With the trainer on a constant heading, the radio compass indicator hand may be rotated by the knob at the desk control unit, thus positioning the armature of the lower of the two teletorque motors in the base, which in turn positions the armature of the upper teletorque motor. The relationship between the armature and field coils in the upper of the two teletorque motors in the base is transmitted to the teletorque motor in the indicator on the instrument panel and positions the indicator hand accordingly. On the other hand, if the trainer is rotated, the shell of the upper of the two teletorque motors in the base is rotated and changes the magnetic relationship between the armature and the field coil. Through the slip rings the magnetic field is changed in the radio compass indicator, thus changing the position of the armature of the indicator teletorque motor.

e. Power supply for the primaries or armatures of the teletorque motors is a 32-volt transformer lo-

cated in the base junction box. (See figure 47 for representative teletorque circuit diagram.)

37. INSTRUMENT AND RECORDER LIGHTS.

a. Twelve-volt, 6-candle power, double-contact bulbs are used for instrument lights. Current is obtained from the 110-volt—12-volt transformer located in the control box in the trainer cockpit.

Note

If it is necessary to trace the wiring, it should be remembered that the current for the left-hand light is conducted into the door of the fuselage through the door hinges.

b. Two fluorescent lamps (figure 59) are used to activate the luminous dials of the instruments. The power supply for the lamps is obtained from two high reactance transformers located in the fuselage control box. Bulbs for these lamps are the 4-watt size. The amount of light is governed by a shutter control (5) located on the top of each lamp. Rotation of this unit controls the intensity of the light.

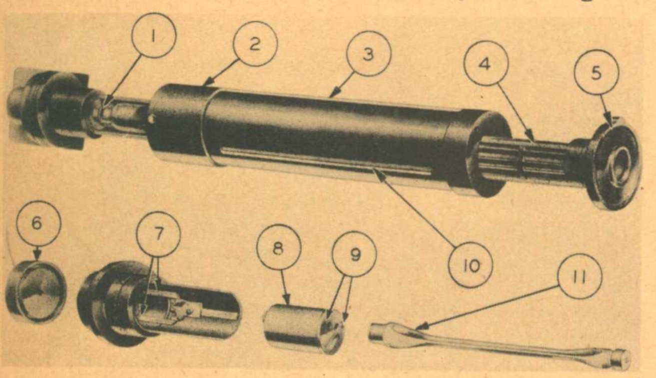


Figure 59—Fluorescent Lamp

1. *Clip Fasteners*
2. *Case*
3. *Ultra-Violet Screen*
4. *Shutter*
5. *Shutter Control*
6. *Plug*
7. *Prongs*
8. *Starter*
9. *Slots*
10. *Daylight Effect Slot*
11. *Base*

c. A control is also provided for daylight or ultraviolet light. By rotating the case (2) ultra-violet light is produced by a violet screen (3) built into the case, while the daylight effect is obtained through slot (10).

CAUTION

The shutter of the lamp is made of Bakelite and should be handled carefully when dismantling or reassembling.

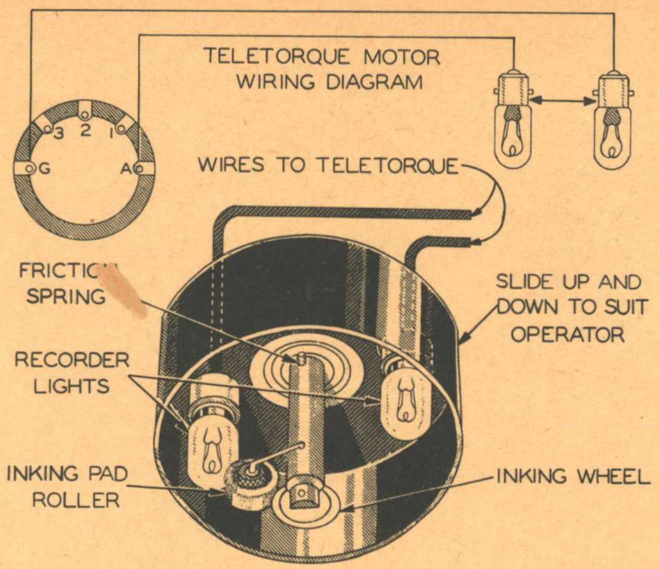


Figure 60—Recorder Lights

d. The automatic recorder uses two 25-volt, .2-ampere single-contact bulbs (figure 60). These bulbs are in series and obtain power from the 32-volt terminals (A) and (G) on the automatic recorder teletorque motor. Since these bulbs are in series, one bulb will not light if the other is burned out. Any break in the circuit will shut off both lights. The recorder light assembly is held in place by a friction spring and may be raised or lowered by the operator as required.

38. CONSTANT VOLTAGE TRANSFORMER.
(*See figure* 61.)

This unit delivers a constant voltage irrespective of instantaneous or continuous variations in the line voltage. This is accomplished chiefly by a combination of a resonant electrical circuit and a high leakage-reactance magnetic circuit. The resonant circuit stabilizes the voltage, while the magnetic circuit tends to prevent changes in the voltage. A compensating winding is connected in series with the output and opposes small changes which appear in the output. Due to the fact that this regulating effect is attained by means of the magnetic relationship between core and coil components, the unit has no moving parts and, therefore, nothing which requires adjustment or maintenance.

39. VIBRATOR MOTORS.
(*See figure* 104.)

a. Three of these units are used in the trainer to provide sufficient vibration for smoothing out the operation of the instruments. These units are lo-

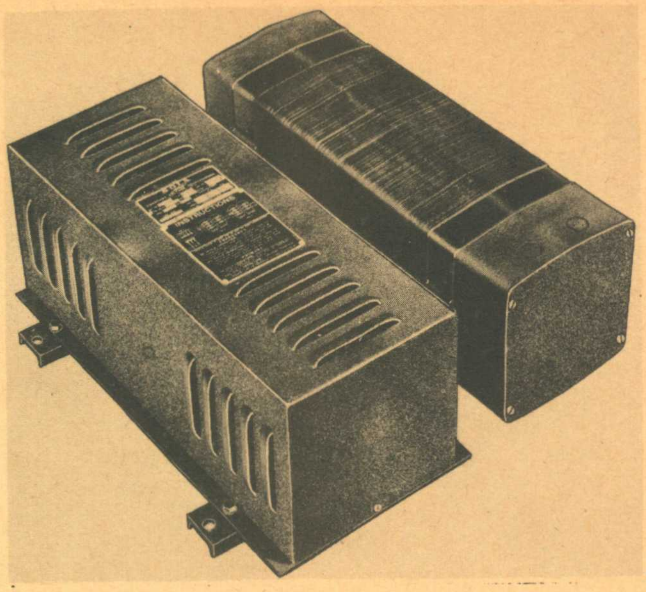


Figure 61—Constant Voltage Transformer

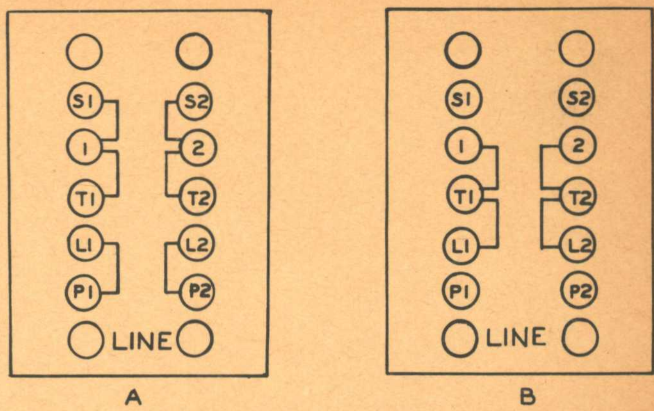


Figure 62—Constant Voltage Transformer Transfer Hook-up. (Showing Base Junction Box Jumper Connections (A) with the Transformer in the Base and (B) Transformer Remotely Located or not Used. Where Trainers Have Been Built to Operate with the Transformer in the Base, the Jumpers Must Be Changed from Connection (A) to Connection (B).)

cated as follows: one on the instrument panel in the cockpit, one on the panel behind the cockpit in the rear of the fuselage, and one in the remote instrument box on the operator's desk.

b. Each unit consists of a constant-speed motor having two small eccentrically mounted flywheels on its shaft. The required amount of vibration is obtained by changing the position of the flywheels on the shaft.

c. The vibrator motors are connected to the ignition switch and operate whenever this switch is turned on.

40. ELECTRICAL SYSTEM.

Current for the operation of the electrical equipment of the trainer first enters the junction box in the trainer base where it is switched to the constant voltage transformer. (See wiring diagram, figure 123.) From this transformer, current is distributed throughout the trainer through the following distribution points:

Note

When the constant voltage transformer is not used, the line current goes directly into the base junction box.

a. BASE JUNCTION BOX.

(1) This unit serves as a terminus for the wiring of all electrical equipment in the base of the trainer and electrically connects the fuselage and desk. (See figure 4 and wiring diagram, figure 123.)

(2) The base junction box also contains the following electrical units:

(*a*) The magnetic switch for the turbine motor.

(*b*) A stepdown transformer, supplying power for the teletorque motors.

(*c*) A supply transformer, with dry disk rectifier and associated filter, for supplying the direct (brake) current to the recorder motors.

b. COLLECTOR RING ASSEMBLY. (*See figure* 5.)

(1) This assembly is mounted on the main spindle and rotates with the trainer.

(2) It consists of a stack of 28 metallic disks (collector rings) with suitable insulation between each disk, the assembly terminating in a row of 28 terminals at the top. Each terminal is connected to its collector ring by means of a metal post which passes through the rings separating the terminal from the ring to which it is connected.

(3) Current is carried from the base junction box to 28 stationary contacts (brushes), mounted on the spindle bearing housing, which ride the collector rings. Current passes through the collector rings and to the terminals at the top of the collector ring assembly, from where it is transmitted through

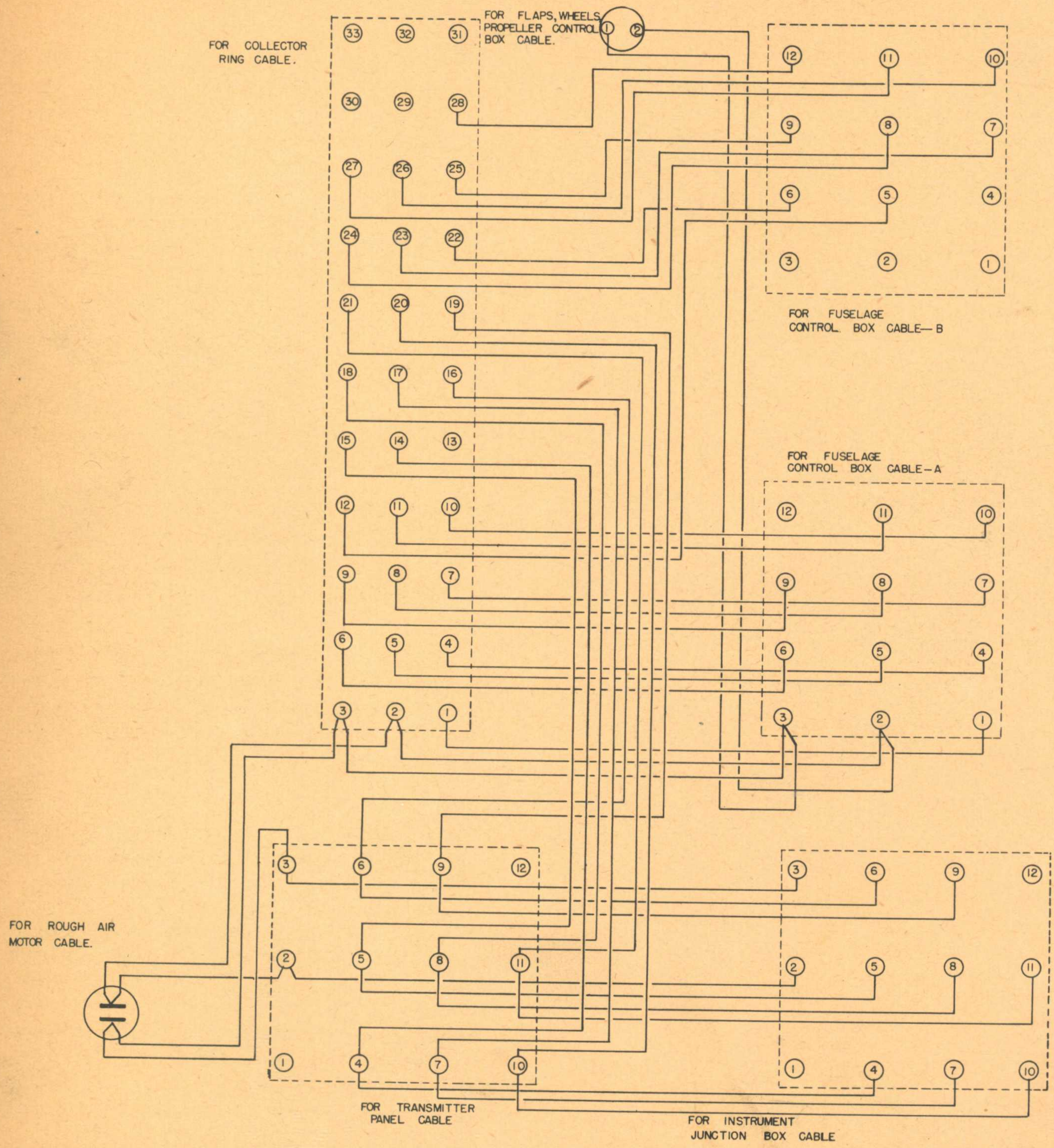


Figure 63—Interconnector Box, Wiring Diagram

the spindle wiring into the interconnector box in the fuselage.

(4) Twenty-two of the 28 collector rings are used for the operation of present electrical mechanisms in the trainer, leaving six spare rings for possible future additions.

c. FUSELAGE INTERCONNECTOR BOX.
(*See wiring diagram, figure* 63.)

(1) This unit serves as a terminus for the various electrical circuits in the fuselage.

(2) Current is distributed through this terminus to the landing gear, propeller pitch, and flap control device, transmitters for the remote indicating instruments, the fuselage control box, and the remote instrument junction box.

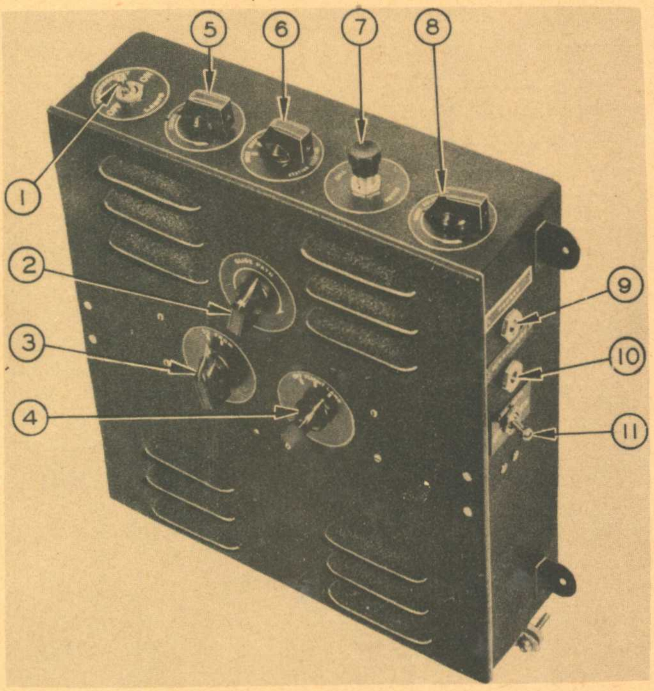


Figure 64—Fuselage Control Box

1. ***Fluorescent Lamp Switch***
2. ***Glide Path Control***
3. ***To-From Switch***
4. ***Flight Land Switch***
5. ***Cockpit Lighting Control***
6. ***Identification Selectoral***
7. ***Call Signal Switch***
8. ***Radio Volume Control***
9. ***Headphone Jack***
10. ***Microphone Jack***
11. ***Landing Instrument Switch***

d. FUSELAGE CONTROL BOX.
(*See figure* 64.)

(1) The fuselage control box is mounted in the right-hand side of the trainer cockpit and serves as a distribution point for current required for operation of electrical equipment on the fuselage instrument panel.

(2) It contains headphone and microphone jacks, together with the necessary controls and switches for operation of the radio and landing systems by the student in the trainer.

(3) Within the fuselage control box are also located two fluorescent light current supply transformers and an additional transformer supplies current to the cockpit lights, compass deflector coils, and the call signal switch. The compass deflector rectifier and adjustable resistor are also located in the fuselage control box.

e. REMOTE INSTRUMENT JUNCTION BOX. (*See wiring diagram, figure* 65.)

(1) This junction box is located forward of the trainer instrument panel on the left side of the fuselage.

(2) It is electrically connected to the fuselage interconnector box and acts as a distribution point for current for the telegon instruments on the trainer instrument panel and the ventilating fan in the nose of the trainer.

Note

On trainers bearing Link Serial No. 5551 and up, the remote instrument junction box has been discontinued and distribution of current to the telegon instruments on the instrument panel and the ventilating fan is effected through a terminal strip on the rear of the instrument panel.

f. DESK JUNCTION BOX. (*See wiring diagrams, figures* 66 *and* 67.) This unit is mounted in the back of the operator's desk and is the terminus for the various electrical circuits in the desk.

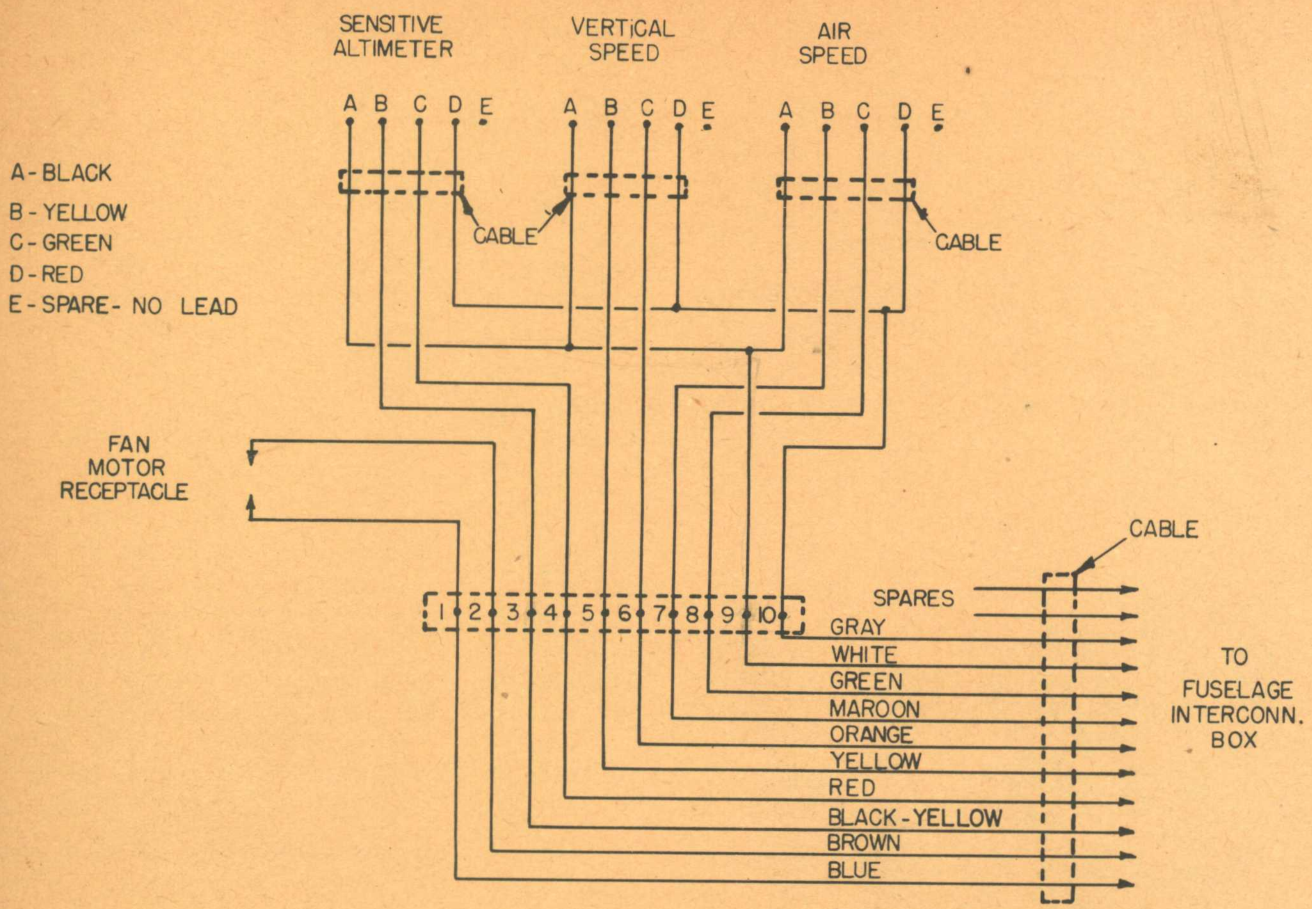


Figure 65—Remote Instrument Transmitter Panel Junction Box, Wiring Diagram

SECTION IV
DISASSEMBLY, INSPECTION, REPAIR, AND REASSEMBLY

1. SPECIAL OVERHAUL TOOLS REQUIRED.

(*See figure* 109.)

PART NO.	NOMENCLATURE	PURPOSE
T-9303	Wind drift setting gage	To set ground speed
T-9304	Wind drift setting gage	To set air-speed carriage
T-9307	Wind drift setting gage	To set wind velocity

2. GENERAL DISASSEMBLY.

a. PRE-DISASSEMBLY CHECK.

(1) Inspect the entire trainer, making notes of needed repairs so they may be executed with a minimum of delay as the work of overhauling proceeds.

(2) See that adequate storage racks, tables, or boxes are placed within easy reach. Safe, accessible storage space will save time and will decrease the possibility of loss or damage to small trainer parts. Do not use the operator's desk as a work bench or as storage space for trainer parts.

b. POWER AND COMMUNICATION CONNECTIONS.

(1) Disconnect the trainer from the main power supply.

(2) If the constant voltage transformer is being used, disconnect the transformer leads from

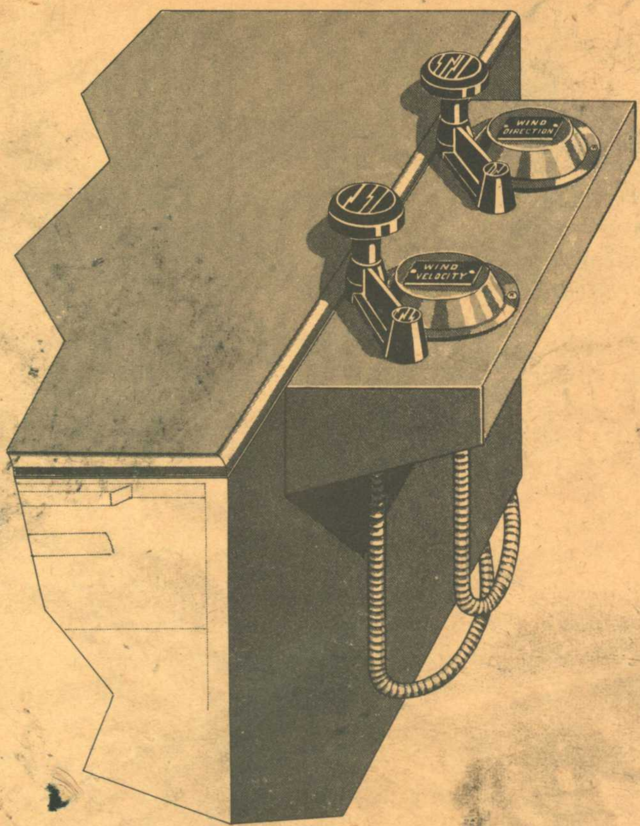


Figure 68—Wind Drift—Desk Control Unit

their terminals in the base terminal box. (See figure 62.)

(3) Disconnect and remove the headphone and microphone from the fuselage.

c. HOOD AND DOOR.

(1) HOOD.

(*a*) Disconnect the electrical connections from inside the fuselage leading to the flap control, landing gear, and propeller pitch control box (indicator control box) on the inside forward end of the hood. Pull the cotter pin from the rear hood hinge pin and remove the hood from the fuselage by sliding it either to the front or to the rear to clear the hinge pins from their hangers.

(*b*) Remove the lock, lifting handle, and hook for headphones from the hood.

Note

If the hood does not require re-covering or painting, hardware should not be removed.

(*c*) Remove the indicator light control box.

1. Disconnect the plug near the top of the fuselage.

2. Remove the four nuts attached to the box.

3. Remove the plug on the side of the assembly box.

4. Remove the insulated staples from the wires.

(*d*) Remove the flap control, landing gear, and propeller pitch signal light indicator box located on top of the hood, by unscrewing the four mounting screws.

(2) DOOR.

(*a*) Remove the cockpit door by unbolting the hinges from the door post. Disconnect the electric leads running through the top door hinge to the moonbeam spotlight, and remove the door leaving the hinges attached to the door frame.

(*b*) Tape the hinges in a folded position and remove the door lock and spring door stop.

(*c*) Remove the four side access panels from the fuselage.

d. INSTRUMENTS ON PILOT'S PANEL.

(1) Disconnect all electric and vacuum leads at the rear of the pilot's instrument panel. Label all electric leads as they are disconnected to facilitate their reconnection. This may be accomplished either with specially printed cellulose tape or with small string tags. Be sure to disconnect the fuel gage electric plug connection.

Note

The instruments can be removed more easily if the top half of the control column is also removed at this time. (Refer to paragraph 2*h*(3), of this section.)

(2) Working from the front of main instrument panel, remove instruments in the following order (figure 8):

(*a*) CLOCK.—Remove four Phillips head machine screws.

(*b*) FUEL GAGE.—Remove three Phillips head machine screws.

(*c*) AUTOMATIC RADIO COMPASS.—Remove four Phillips head machine screws.

(*d*) ARMY CROSS POINTER, NAVY CROSS POINTER, OR FLIGHT PATH INDICATOR.—Remove four Phillips head machine screws.

(*e*) MAGNETIC COMPASS. — Remove four Phillips head machine screws.

(*f*) ALTIMETER.—Remove four Phillips head machine screws.

(*g*) DIRECTIONAL GYRO.—Remove four Phillips head machine screws. (Prior to Link Serial No. 7714, the trainer equipment included Sperry directional gyro.)

(*h*) LINK SIMULATED DIRECTIONAL GYRO. — Remove four Phillips head machine screws attaching instrument to the pilot's panel. Disconnect electric plug and flexible shaft in rear of panel, and remove instrument. (Effective with Link Serial No. 7714, the Link simulated directional gyro became standard equipment on instrument flying trainers.)

(*i*) ARTIFICIAL HORIZON. — Remove four Phillips head machine screws.

(*j*) MANIFOLD PRESSURE INDICATOR.—Remove four Phillips head machine screws.

(*k*) AIR-SPEED INDICATOR.—Remove four Phillips head machine screws.

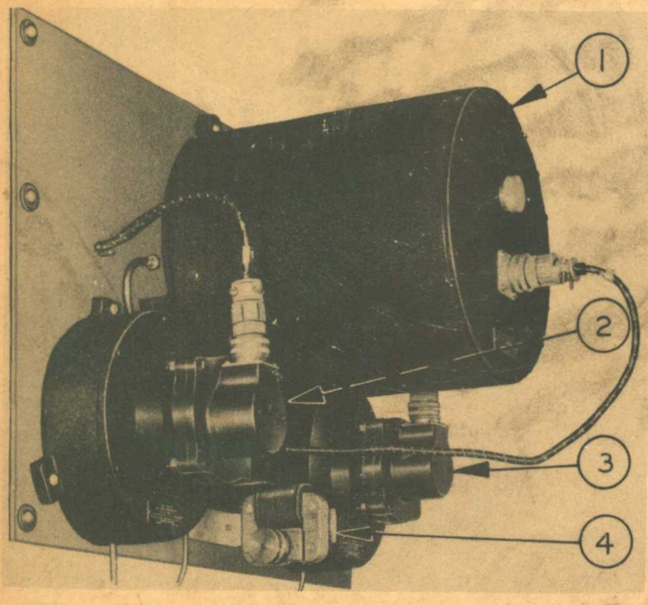


Figure 69—Remote Instrument Transmitter Panel

1. *Vertical-Speed Transmitter*
2. *Air-Speed Transmitter*
3. *Altimeter Transmitter*
4. *Vibrator Motor*

(*l*) TURN AND BANK INDICATOR.—Remove four Phillips head machine screws.

(*m*) VERTICAL-SPEED INDICATOR.—Remove four Phillips head machine screws.

(*n*) VIBRATOR MOTOR.—Label vibrator motor leads to facilitate reassembly. Unsolder leads, remove the two Phillips head machine screws holding the vibrator motor bracket to the panel, and remove the motor and bracket as a unit.

e. REMOTE INSTRUMENT TRANSMITTERS. (*See figure* 69.)

(1) CONNECTIONS.—The remote instrument transmitters are mounted on a special panel directly behind the pilot's seat. Disconnect and label the electrical connections.

(2) AIR-SPEED TRANSMITTER. — Support the transmitter and remove its three panel mounting screws. Tilt the transmitter away from the panel, disconnect the copper tubing lead to the base of the transmitter, and remove the transmitter.

CAUTION

When removing the air-speed transmitter be sure not to bend the capillary tube inside the copper tubing.

(3) ALTIMETER TRANSMITTER.—Support the transmitter and remove the three panel mounting screws. Tilt the transmitter away from the panel, disconnect the copper tubing lead to the base of the transmitter, and remove the transmitter.

Note

The copper tubing lead for the altimeter transmitter may be first disconnected at the T-joint beneath the panel and from the transmitter after removal from the fuselage. This is also true of the copper tubing in the vertical-speed transmitter.

(4) VERTICAL-SPEED TRANSMITTER. —Support the transmitter and remove the three mounting screws. Remove the transmitter from the fuselage, being careful not to damage the copper tubing.

f. CONNECTIONS TO OPERATOR'S DESK UNIT.

(1) Disconnect the main power cable leading to the desk junction box by pulling the 33-contact Jones plug from the rear of the base terminal box.

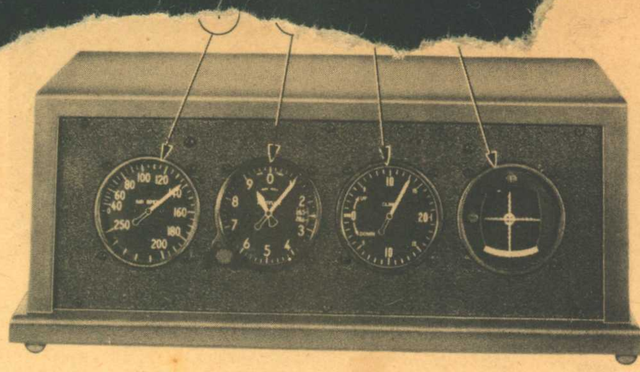


Figure 70—Remote Instrument Case (Front View)

1. Air-Speed Indicator
2. Altimeter
3. Vertical-Speed Indicator
4. Army Cross Pointer Indicator (Also position of Landing Path Indicator used with Navy and British Landing System)

(2) Unscrew the two flexible shafts leading from the wind drift mechanism in the base of the trainer to the wind drift control mechanism on the right-hand end of the operator's desk. Disconnect these flexible shafts at both ends.

(3) Disconnect and remove headphone and microphone from the desk. Unclip the microphone from the desk stand.

g. WINGS, EMPENNAGE, AND FITTINGS.

(1) Remove the four wood screws securing the rudder brackets to the fuselage.

(2) Remove the rudder with the brackets attached.

(3) Remove the four wood screws securing the elevator and stabilizer brackets and braces to one side of the fuselage.

(4) Repeat the same procedure to remove the opposite elevator and stabilizer.

(5) Remove the two machine screws securing each wing to the fuselage.

(6) Remove the supporting rods attached to the wings by removing the nuts and washers fastening the rods to the fuselage and the nuts and washers fastening the rods underneath the wings.

Note

Trainers manufactured prior to Link Serial No. 5009 were equipped with movable ailerons. In removing the wings from these trainers, the aileron control cables should first be disconnected by removing the setscrews in the cable terminals attached at the bottom of the control column. The cables will pull out through holes in the fuselage and wing coverings and remain attached to the wings as they are removed. Trainers manufactured prior to Link Serial No. 5019 were equipped with movable rudder and elevator controls. In removing the rudder from these trainers, the rudder link rod, connected to the rudder bar, should be disconnected at each end and removed prior to removal of the long hinge pin and disassembly of the rudder. In removing the elevators, first remove the elevator link rods and then disassemble the elevators by removing the elevator hinge pins.

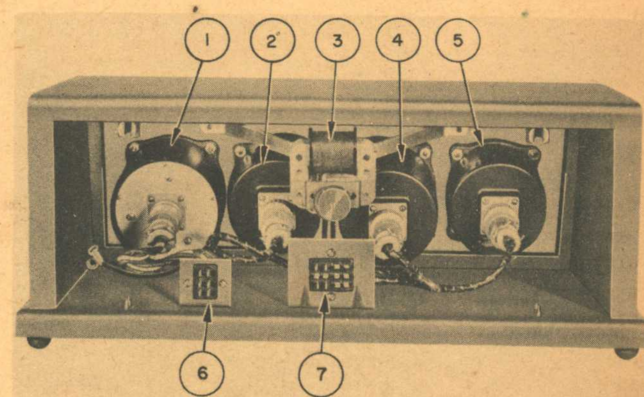


Figure 71—Remote Instrument Case (Rear View)

1.—Army Cross Pointer Indicator (Also position of Landing Path Indicator used with Navy and British Landing System)
2. Vertical-Speed Indicator
3. Vibrator Motor and Bracket
4. Altimeter
5. Air-Speed Indicator
6. Landing Instrument Cable Plug
7. Main Cable Plug

(7) Remove all handles, brackets, peephole casing, ventilator shields, and other exterior fittings which would interfere with repainting the plywood covering on the fuselage or re-covering trainers having a fabricated fuselage.

Note

Instrument flying trainers, Link Serial Nos. 4395 to 4733, were completely covered with fabric. Effective with Link Serial No. 4734 the wings were changed from fabric to plywood covering, while the rest of the fuselage remained covered with fabric. Ef-

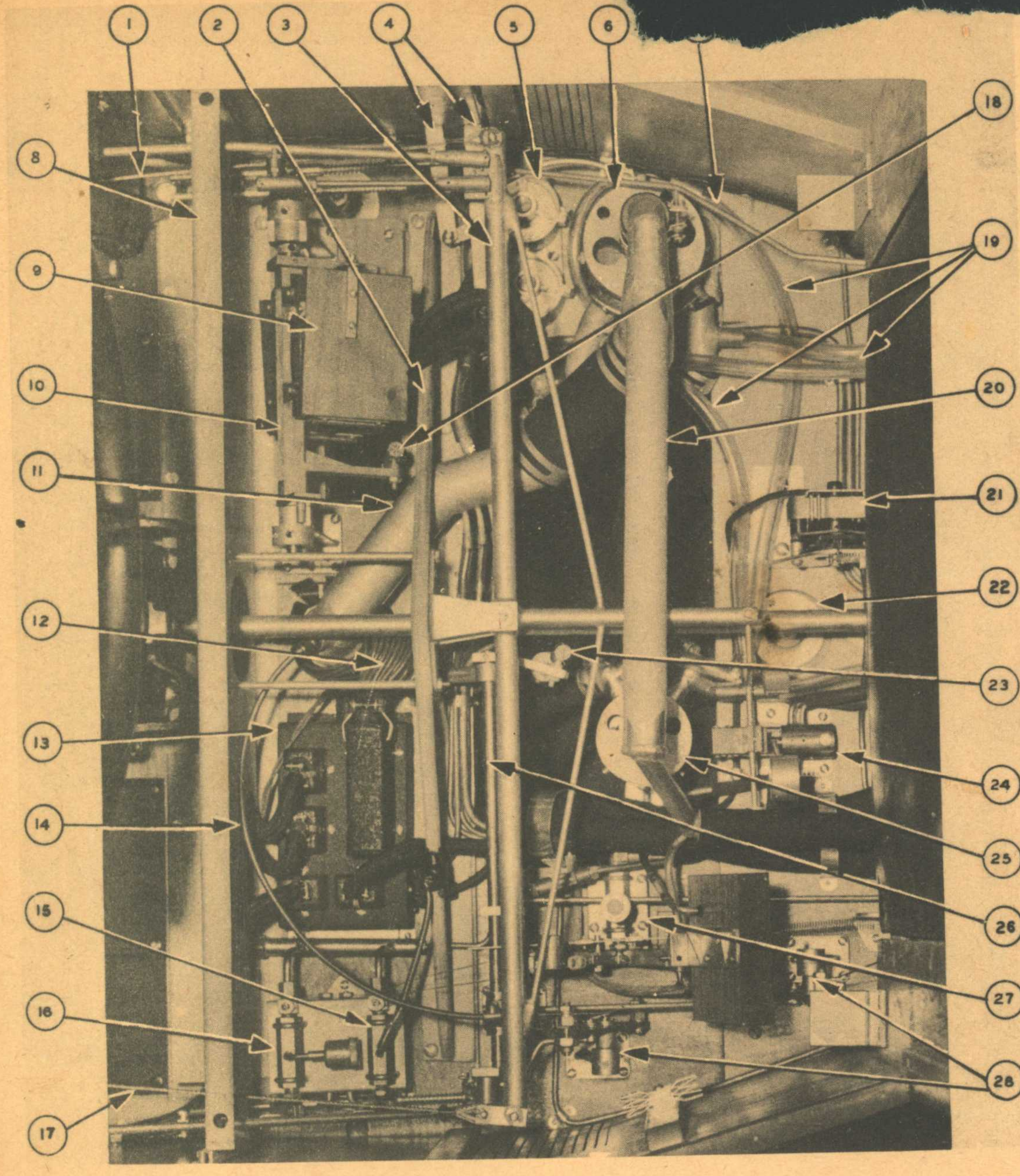


Figure 72—Floor of Fuselage

1. *Right Rudder Cable*
2. *Cantilever Brace*
3. *Rudder Bar*
4. *Shut-Off Slides*
5. *Shut-Off Valves for Directional Gyro and Turn and Bank Indicator*
6. *Rudder Valve*
7. *Link Rod to Aileron Valve Bell Crank*
8. *Baffle Plate*
9. *Spin Trip Assembly (Bellows)*
10. *Bank Turner Assembly*
11. *Conductor Elbow*
12. *Spindle Wiring*
13. *Interconnector Box*
14. *Air-Speed Cable Sheathing*
15. *Climb Valve*
16. *Dive Valve*
17. *Left Rudder Cable*
18. *Bank Turner Link Rod*
19. *Rough Air Vacuum Lines*
20. *Main Air Transfer Manifold*
21. *Rough Air Motor*
22. *Rear Bellows Stud Ball Socket*
23. *Pitch Action Compensator*
24. *Spin Valve*
25. *Elevator Valve*
26. *Pitch Action Assembly*
27. *Stall Valve*
28. *Manifold Pressure Indicator and Air-Speed Indicator Pedestal Brackets*

fective with Link Serial No. 4888, the complete fuselage is covered with plywood.

(8) Remove the pilot's seat by lifting it straight up.

(9) Remove the black cloth skirt by unsnapping it from the base of the fuselage.

h. FUSELAGE INTERIOR.

(1) RUDDER CONTROLS. (*See figure* 24.)

(*a*) Disconnect the simulator link rod at the right-hand end of the rudder bar (16).

Note

Effective with Link Serial No. 5019 the rudder control surfaces became fixed and the rudder bar link rod was connected to the aileron valve instead of to the rudder bell crank (17).

(*b*) Disconnect the slip-stream simulator link rod at the simulator arm (5).

(*c*) Disconnect the cables leading to the rudder bar at the rudder pedals (4) and (13).

(*d*) Disconnect the ball joint at the top of the spin trip walking beam (6).

(*e*) Disconnect the fork to the spin valve at the end of the rudder bar tee (14).

(*f*) Remove the nuts from the two long rods extending through the cantilever brace.

(*g*) Remove the rudder bar (16) with its pivot bracket from the fuselage.

(2) MAIN AIR TRANSFER MANIFOLD. (*See figure* 72.)

(*a*) Loosen the hose clamps from the hose extending to the conductor elbow and from the hose extending to the rudder valve.

(*b*) Remove these two hose and also the hose leading to the aileron valve, elevator valve, and the tubing leading to the stall valve bellows.

(*c*) Lift out manifold.

(3) CONTROL COLUMN—WHEEL TYPE. (*See figures* 73 *and* 74.)

(*a*) Remove capscrews (3, figure 73) and tip the upper part of the control column to the rear of the trainer until the aileron link (4, figure 73) can be slipped clear of the link pin (5, figure 73).

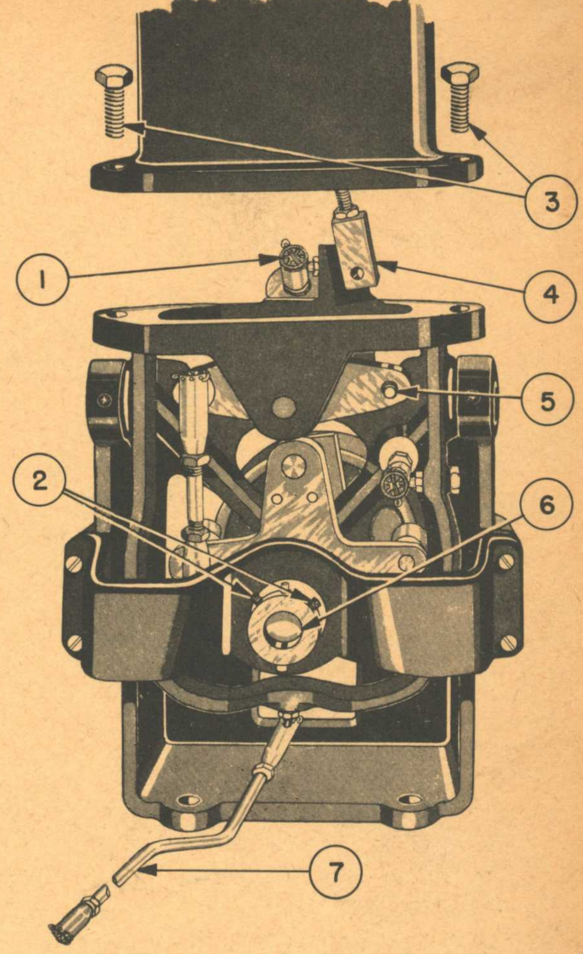


Figure 73—Control Column Base

1. *Aileron Control Lever Ball Joint*
2. *Setscrews (Torque Shaft)*
3. *Capscrews (Control Column)*
4. *Aileron Link*
5. *Link Pin*
6. *Torque Shaft*
7. *Link Rod to Elevator Valve*

(*b*) Lift the control column clear, being careful not to damage the aileron link.

(4) CONTROL COLUMN—STICK TYPE.—Unscrew the stick and remove it from the control column base.

(5) CONTROL COLUMN BASE. (*See figure* 73.)

(*a*) Disconnect the ball joint (1) at the aileron control arm.

(*b*) Disconnect the ball joint from the simulator arm.

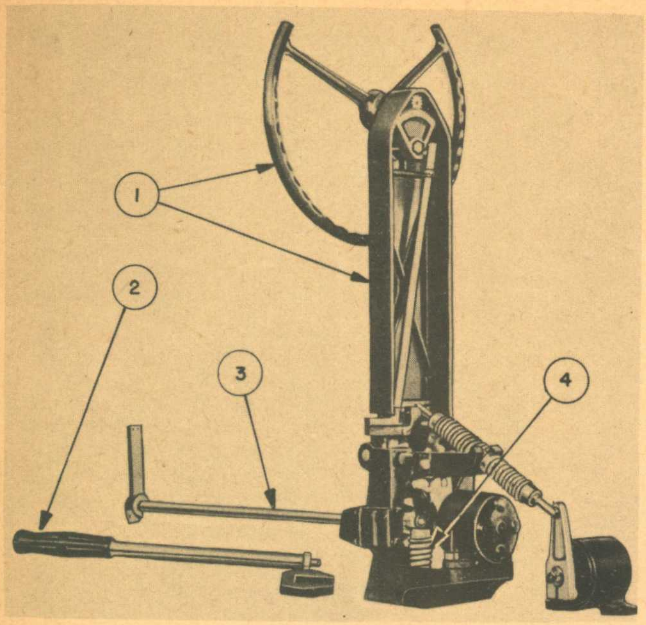


Figure 74—Control Column—Wheel and Stick

1. Control Wheel and Column
2. Control Stick
3. Torque Shaft
4. Aileron Control Spring (Left)

(*c*) Loosen setscrews (2) in the casting holding the torque shaft.

(*d*) Loosen the aileron control arm at the rear end of the torque shaft.

(*e*) Push the torque shaft toward the rear of the trainer.

(*f*) Remove the capscrews holding the simulated directional gyro shaft clamp to the base of the control column. (See figure 80.)

(*g*) Remove the four screws mounting the control column base to the floor of the trainer and lift out the control column base.

Note

Care should be exercised not to damage the rod to the elevator valve.

(6) SIMULATED DIRECTIONAL GYRO FLEXIBLE SHAFT. (*See figure* 80.)

(*a*) Remove the wood screws attaching the flexible shaft bracket to the floor of the fuselage.

(*b*) Disconnect the shaft at the directional gyro take-off assembly attached to the main spindle beneath the octagon and remove the flexible shaft through the floor of the fuselage.

Note

Link instrument flying trainers manufactured prior to Link Serial No. 7714 were equipped with a Sperry directional gyro instead of the Link simulated directional gyro. To remove the Sperry directional gyro from the trainer, it is only necessary to remove the mounting screws from the instrument.

(7) TORQUE SHAFT.—Remove the torque shaft by pulling the shaft toward the front end of the trainer until it clears through the aileron control arm and bracket.

(8) CONDUCTOR ELBOW.

(*a*) Remove the trainer base panels by inserting fingers in the holes and pulling outward on the panels.

(*b*) Disconnect the bronze air-speed cable at the snap swivel. (See figure 81.)

CAUTION

This cable connects to a spring loaded reel inside the wind drift mechanism and, to avoid breakage it must be reeled back into the wind drift mechanism very slowly.

(*c*) Feed the air-speed cable back very slowly into the wind drift case until it is stopped by the small metal washer soldered to the base of the cable snap swivel.

(*d*) Remove the split lock washer at the base of the transfer elbow (5, figure 81) which holds the throttle sheathing bushing to the transfer elbow.

(*e*) Loosen the sheathing from the pitch action bracket in the fuselage. Loosen the air-speed wire leading to the air-speed reversing arm by loosening two clamp nuts.

(*f*) Loosen the hose clamp at the top of the spindle assembly.

(*g*) Lift out the conductor elbow, leaving the throttle sheathing connected.

Note

Care should be taken not to bend or damage the sheathing.

(*h*) If it is necessary to replace the throttle or air-speed cable sheathing (14, figure 72), proceed as follows:

1. Loosen the clamping nut on top of the conductor elbow.

2. Pull the sheathing up until the soft brass bushing is exposed. File the bushing through, being careful not to damage the sheathing.

3. Remove the sheathing from the conductor elbow.

4. Install new sheathing in the transfer elbow (5, figure 81), secure the bushing at the bottom with a split lock washer and brass washer, pass the sheathing up through the spindle, and through the conductor elbow, put on a new soft brass bushing, and screw down the retaining nut.

(9) VALVES. (*See figure* 72.)—Proceed as follows to remove the valves from the fuselage, labeling each hose connection as it is removed to facilitate reassembly:

(*a*) CLIMB-DIVE VALVES. (*See figure* 72.)

1. Disconnect the copper tubing joints at their junction with the valve bodies by removing the compression nuts.

2. Disconnect the tubing lead to the climb valve.

3. Remove the cotter pin or spring clip from the compensator assembly link rod connected at the walking beam on the pitch action shaft (23, figure 27).

4. Remove the three mounting screws from the valve base.

5. Replace the cotter pin or spring clip in the linkage after removing the climb-dive valve.

(*b*) RUDDER VALVE. (*See figure* 72.)

1. Loosen the two hose clamps and remove the hose.

2. Disconnect the two rough air tubing leads to the rudder valve.

3. Disconnect the wiring to the compass deflector switch contacts and the ground wire to the lower section of the valve.

4. Disconnect the bank turner link rod from the center arm of the rudder valve.

5. Loosen the setscrews underneath the fuselage holding the rudder valve spindle.

6. Remove the rudder valve from the fuselage.

(*c*) ELEVATOR VALVE. (*See figure* 72.)

1. Loosen the two hose clamps and remove the hose.

2. Disconnect the two rough air tubing leads from the elevator valve.

3. Loosen the setscrews in the pedestal bracket holding the valve spindle.

4. Remove the elevator valve from the fuselage.

(*d*) AILERON VALVE. (*See figure* 2.)

1. Loosen the two hose clamps and remove the hose.

2. Disconnect the two rough air tubing leads from the aileron valve.

3. Loosen the setscrews holding the valve spindle.

4. Disconnect the two link rods attached to the valve and push the valve toward the front of the trainer.

5. Remove the aileron valve from the fuselage.

(*e*) SPIN VALVE. (*See figure* 72.)

1. Detach all tubing.

2. Remove the four wood mounting screws holding the base of the valve to the fuselage floor and lift out the valve.

(*f*) STALL VALVE. (*See figure* 72.)

1. Detach all tubing.

2. Disconnect the stall valve bellows spring from the bracket.

3. Disconnect the copper tubing at its junction with the valve.

4. Remove the four wood mounting screws holding the base of the valve to the floor of the fuselage and lift out the valve.

(*g*) DIRECTIONAL GYRO AND TURN AND BANK INDICATOR SHUT-OFF VALVE. (*See figure* 72.)

1. Remove all tubing.

2. Remove the spring clips from the operating arms and remove the arms.

3. Remove the two mounting screws holding the base of the valve to the floor of the fuselage and lift out the valve assembly.

(10) SPIN TRIP ASSEMBLY. (*See figures* 24 *and* 72.)

(*a*) Disconnect the three tubing leads, one to each bellows.

(*b*) Disconnect the bank turner link rod (10, figure 24) at the horizontal arm (B) of the spin trip assembly.

(*c*) Remove the link rods from the walking beam (6, figure 24).

(*d*) Remove the four wood mounting screws. Two are located directly in the wood base and two go through the outer corners of the pedestal brackets and then through the wood base.

(*e*) Lift the spin trip assembly from the fuselage.

(11) BANK TURNER LINK ROD.—Disconnect the ball joint of the bank turner link rod (10, figure 24) from the stud in the octagon cross, and lift the rod up through the floor of the fuselage.

(12) PITCH ACTION COMPENSATOR. (*See figure* 30.)

(*a*) Disconnect the pitch action compensator (7) from the horizontal arm (6) of the pitch action assembly.

(*b*) Disconnect the ball joint at the base of the compensator from the stud in the octagon cross.

(*c*) Remove the pitch action compensator.

(13) SLIP-STREAM SIMULATORS.

(*a*) Remove the two mounting bolts and lift out the elevator simulator (30, figure 2).

(*b*) Remove the two mounting bolts and lift out the rudder simulator (12, figure 2).

(*c*) The aileron simulator (31, figure 2) is removed from the trainer fuselage with the control column base and is disassembled therefrom by removal of two mounting bolts.

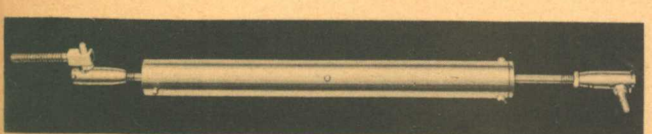


Figure 75—Pitch Action Compensator

(14) MAIN BELLOWS LINKAGE.

(*a*) At this point in the trainer disassembly, the four ball nuts connecting the main bellows to the trainer fuselage are exposed and should be disconnected, permitting the four main bellows to settle down inside the octagon. (See 22, figure 72.)

(*b*) After each ball nut has been disconnected and the bellows allowed to settle, reassemble the ball nuts and locking nuts to the bellows hook-up studs.

(15) BELLOWS IN FUSELAGE.

(*a*) AIR-SPEED REGULATOR BELLOWS. (*See figure* 26.)

1. Disconnect tubing and linkages.

2. Remove the six mounting screws from the brackets attached to the left-hand wall of the fuselage and remove the bellows and brackets as an assembly.

(*b*) MANIFOLD PRESSURE OR TACHOMETER REGULATOR BELLOWS. (*See figure* 26.)

1. Disconnect tubing and linkages.

2. Remove the six mounting screws from the brackets attached to the left-hand wall of the fuselage and remove the bellows and brackets as an assembly.

(*c*) TURN AND BANK INDICATOR REGULATOR BELLOWS. (*See figure* 2.)

1. Disconnect the two tubing leads to the bellows.

2. Remove the mounting screws and take out the bellows and brackets as an assembly.

Note

The turn and bank indicator bellows is mounted on the right wall of the fuselage just forward of the fuselage control box.

(16) PITCH ACTION ASSEMBLY. (*See figure* 30.)

(*a*) Remove the two screws attached to the pitch action shaft bracket (5) near the center of the trainer.

(*b*) Remove the four wood screws from the air-speed cable bracket (3).

(*c*) Disconnect the walking beam (9) at the top.

(*d*) Move the pitch action assembly toward the right and lift it out of the fuselage.

(17) ROUGH AIR GENERATOR. (*See figure* 22.)

(*a*) Disconnect the electric leads to the rough air generator motor (21, figure 72) by pulling the plug from the interconnector box (13, figure 72).

(*b*) Remove the motor bracket mounting screws, disengage the gears, and lift out the motor.

(*c*) Disconnect the six tubing leads to the rough air generator.

(*d*) Remove the two base mounting screws and lift out the rough air generator and mounting base as an assembly.

(18) THROTTLE ASSEMBLY. (*See figure* 76.)

(*a*) Remove the cotter pin and washer at the lower end of the throttle lever and spring the arm free of the intermediate lever mounting block pin.

(*b*) Remove the ball joint on the adjustable link rod at the throttle lever end.

(*c*) Remove the two screws running through the mounting quadrant and lift out the assembly.

(*d*) Remove adjustable link rod (2, figure 76) by loosening the lock nut on the ball joint connected to the walking beam and turning the rod counterclockwise.

(19) MANIFOLD PRESSURE AND AIR-SPEED PEDESTAL BRACKETS. (*See figure* 72.)

(*a*) Remove the four mounting screws from each pedestal bracket.

(*b*) Disconnect the manifold pressure indicator wire by loosening the clamp nut. The airspeed wire was removed along with the conductor elbow.

(*c*) Lift out the brackets and the connecting rods running to the pitch action walking beam as one unit.

(20) COCKPIT SPOTLIGHTS AND FLUORESCENT LAMPS.

(*a*) Disconnect the electric leads to the fluorescent lamps.

(*b*) Remove the screws from the two mounting brackets and remove the lamps and brackets.

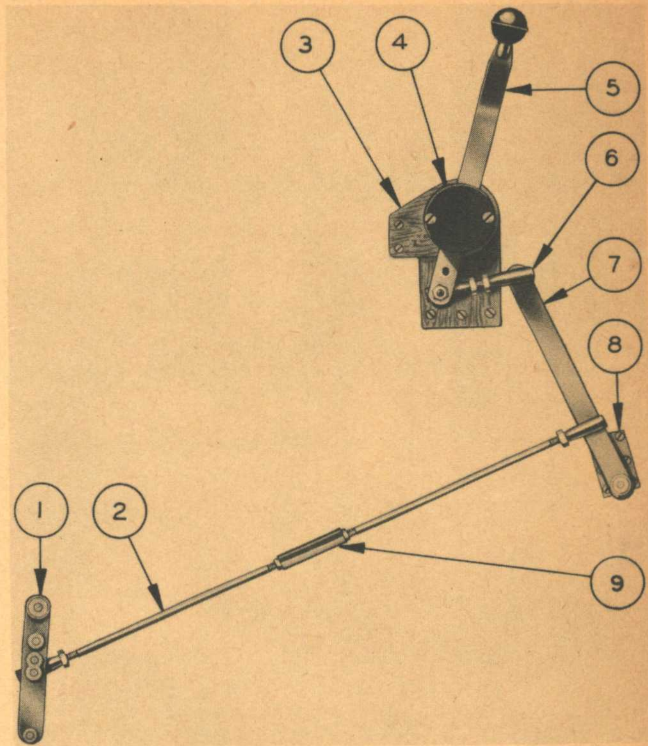


Figure 76—Throttle Assembly

1. Walking Beam (Pitch Action)
2. Adjustable Link Rod
3. Mounting Blocks
4. Throttle Cover
5. Throttle Lever
6. Throttle Rod
7. Intermediate Lever
8. Intermediate Lever Mounting Blade
9. Adjusting Turnbuckle

(*c*) Disconnect the electric leads to the spotlight on the right-hand cockpit wall and remove the spotlight by unfastening the screws holding the mounting bracket to the fuselage wall.

(*d*) Disconnect the electric leads to the spotlight mounted on the door of the fuselage and remove the spotlight by disconnecting it at the pivot joint on the mounting bracket.

(21) RUDDER PEDALS. — Remove the screws holding the rudder pedal brackets to the fuselage floor and remove each rudder pedal, tension spring, and spring eyebolt as a unit. Tie the parts together to prevent loss.

(22) TANKS.

(*a*) AIR-SPEED DAMPING TANK. (*See figure* 2.)

1. Disconnect the two copper tubes from the air-speed tank.

2. Remove the four mounting screws through the two flanges at the base of the tank and remove the tank.

(*b*) CLIMB-DIVE TANK. (*See figure* 2.)

1. Disconnect the copper tubing from the climb-dive tank.

2. Remove the screws holding the canvas apron on the under side of the tank and remove the apron.

3. Remove the wood screws from the tank support.

4. Release the support from the flange on the tank, holding the tank to prevent it from falling on the floor of the fuselage, then carefully remove the tank.

(23) VENTILATING FAN. (*See figure* 2.)

(*a*) Disconnect the electric leads from the fan to the instrument panel.

(*b*) Remove the insulated wire staples holding the electric cable to the fuselage.

(*c*) Remove the three mounting screws from the ring of the fan and lift the fan out of the fuselage.

(24) INSTRUMENT PANELS, BAFFLE PLATE, AND CANTILEVER BRACE.

(*a*) PILOT'S INSTRUMENT PANEL. (*See figure* 2.)

Note

The panel need not be removed unless it requires repainting.

1. See that all cable and tubing attached to the rear of the panel has been removed.

2. Remove the ignition, fuel gage, and pitot heater switches from the panel by unscrewing the knurled collar on the front of the switch, lifting off the switch name plate, and drawing the switch out from the rear of the panel.

3. Unscrew the brass collar from the rear of the marker beacon light tube and draw out the light and socket assembly.

4. Remove the marker beacon jewel hood assembly and light tube by removing its two mounting screws and nuts.

5. Remove the instrument panel terminal block.

6. Label the vibrator motor leads to facilitate reassembly. Unsolder the leads, remove the two Phillips head machine screws holding the vibrator motor bracket to the panel, and remove the motor and bracket as a unit.

7. Remove the instrument panel from the fuselage by taking out the Phillips head screws along the ends and across the top of the panel.

Note

If the compass card frame and name plates are riveted to the instrument panel, mask them with tape before repainting panel. If the frame and plates are mounted to the panel by screws, they should be removed.

(*b*) REMOTE INSTRUMENT TRANSMITTER PANEL. (*See figures 2 and* 69.)—Do not remove this panel unless rewiring is necessary, in which case, proceed as follows:

1. Remove the panel mounting screws.

2. Pull the top of the panel towards the rear of the trainer and disconnect the main cable wires at the terminal strip, then lift the panel out as a unit.

(*c*) BAFFLE PLATE. (*See figure* 72.)—Do not remove the baffle plate unless it is damaged and requires replacement, in which case proceed as follows:

1. Remove the clamps holding the cable and tubing to the fuselage floor.

2. Remove the two wooden shields on the floor in front of the baffle plate.

3. Disconnect all Jones plugs from the fuselage interconnector box.

4. Remove the four bolts and nuts securing the ends of the baffle plate to the fuselage side walls.

5. Spring the cable and tubing enough to permit the removal of the wood screws through the base flange of the baffle plate.

6. Remove the nuts, located on the cockpit side of the baffle plate, from the two rods linking the baffle plate to the cantilever brace.

7. Slide the baffle plate forward until it is clear of the cantilever link rods, wiring, and tubing

along the base. Lift the baffle plate up and back until it can be brought out through the cockpit door.

(*d*) CANTILEVER BRACE. (*See figure* 72.)—Removal of the cantilever brace is not recommended unless the brace is cracked. If it must be removed, proceed as follows:

1. Cut the friction tape binding the climb-dive valve tube to the cantilever brace.

2. Remove the tube clamps holding the group of copper tubes running along the base of the cantilever brace.

Note

To facilitate reassembly, tape the tubes together before completely releasing the tube clamps.

3. Remove the cable clamps from the cable leading to the remote instrument panel and remove the cable.

4. Remove the cantilever brace mounting bolts. Swing the cantilever brace slightly crosswise to clear the remaining tubing and lift it up and out through the cockpit door.

(*e*) VALVE MOUNTING BRACKETS.—Remove the wood screws from the aileron, elevator, and rudder valve mounting brackets. Remove the brackets, placing them with their respective valves.

(25) FUSELAGE CONTROL BOX. (*See figures 2 and* 64.)

(*a*) Pull out the 12-contact plug from the bottom of the fuselage control box and remove the control box cover by pulling directly outward, thus releasing two spring catches, one on each side of the control box.

(*b*) Disconnect at the terminal strips the 36 wires entering the control box at the lower right corner through two cable connectors, being sure to label all wires so they may be reassembled to the proper terminals.

(*c*) Remove four wood screws from the lugs on the outside of the control box and take out the box.

(26) TRANSMITTER PANEL JUNCTION BOX.

(*a*) Disconnect and release from the fuselage junction box, the cable leading to the instrument junction box.

(*b*) Free the cable from its four clamps along the fuselage floor and wall.

(*c*) Dismount the junction box by removing its four mounting screws.

Note

Effective with Link Serial No. 7500 the transmitter panel junction box was discontinued and in its place, leads connected to the fuselage control box and running to a terminal strip on the left side of the transmitter panel were installed.

(27) INTERCONNECTOR BOX. (*See figure* 72.)

(*a*) See that the seven plugs are disconnected.

(*b*) Remove the two screws from the base of the interconnector box on the end farthest from the fuselage door.

(*c*) Slide the flange on the near end of the interconnector base out from under the clip on the floor and lift the box out of the fuselage.

(28) PITOT HEATER SIGNAL LAMP. (*See figure* 77.)

(*a*) Remove the lamp from its socket and disassemble the socket from the mounting bracket.

(*b*) Separate the socket and disconnect the electric leads.

(*c*) Remove the mounting bracket, reassemble the socket halves, and attach the mounting bracket loosely to prevent loss.

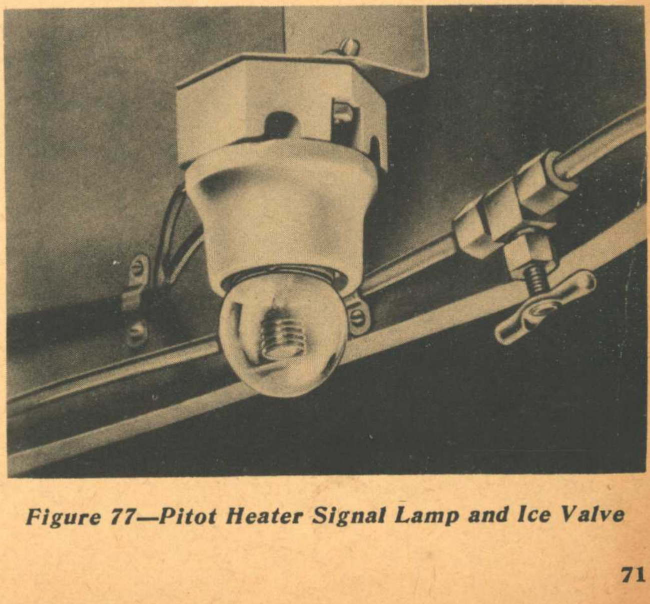


Figure 77—Pitot Heater Signal Lamp and Ice Valve

(29) TUBING AND FLOOR MATS.

(*a*) Remove all rubber hose or transflex tubing still in the trainer.

(*b*) Remove the cockpit floor mats.

Note

If floor mats are not badly worn they should be cleaned and put back into the trainer at reassembly. All rubber hose and transflex tubing should be replaced, regardless of apparent condition.

i. REMOVING FUSELAGE.

(1) Remove the four screws holding the fuselage to the top of the universal joint. If the cantilever brace and the baffle plate have already been removed, only two screws (the ones to right and left) will remain, the forward and rear screws, passing through the baffle plate and the cantilever brace, having been removed with these parts.

(2) Disengage the locking straps.

(3) Lift the fuselage straight up until it clears the spindle and wiring.

(4) Place the fuselage on sawhorses or blocks and remove as much of the remaining equipment and maintenance hardware as is necessary in order to accomplish needed repairs, refabrication, or repainting.

j. REVOLVING OCTAGON.

(1) UNIVERSAL JOINT. (*See figure* 78.)

(*a*) Remove the four capscrews at the base of the universal joint assembly.

(*b*) Remove the leather boot between the universal joint and the spindle wiring.

(*c*) Lift the universal joint straight up until it clears the spindle housing and wiring.

(2) TURNING MOTOR.

(*a*) Remove the two thumb screws holding the turning motor hood and remove the hood by lifting it straight up.

(*b*) Disconnect the hose leads to the turning motor banks.

(*c*) Loosen the belt-tightener pulleys and slip the drive belt off the turning motor pulley and the sheave on the revolving octagon.

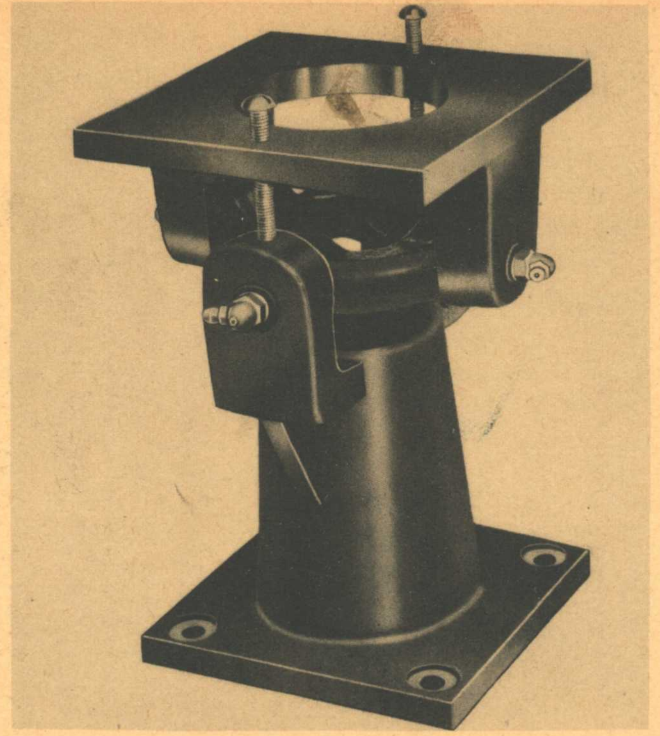


Figure 78—Universal Joint

(*d*) With sufficient help to support the weight of the turning motor, remove the screws mounting the motor to the turning motor brackets.

(*e*) Remove the turning motor brackets from the angle iron supports by removing two bolts and nuts.

Note

Store the motor on its wooden base, placing the hood over it for additional protection.

(3) REMOVING THE OCTAGON. (*See figure* 79.)

(*a*) Remove two small wood screws from the plate (3, figure 80) on the forward side of the octagon through which the operating slide for the simulated gyro passes.

(*b*) Remove the plate, allowing the operating slide to drop down on top of the trainer base.

(*c*) Loosen the two setscrews in the revolving octagon cross. One of these screws is plainly visible and one is directly below on the under side of the cross.

(*d*) Lift the octagon upward until it clears the spindle wiring.

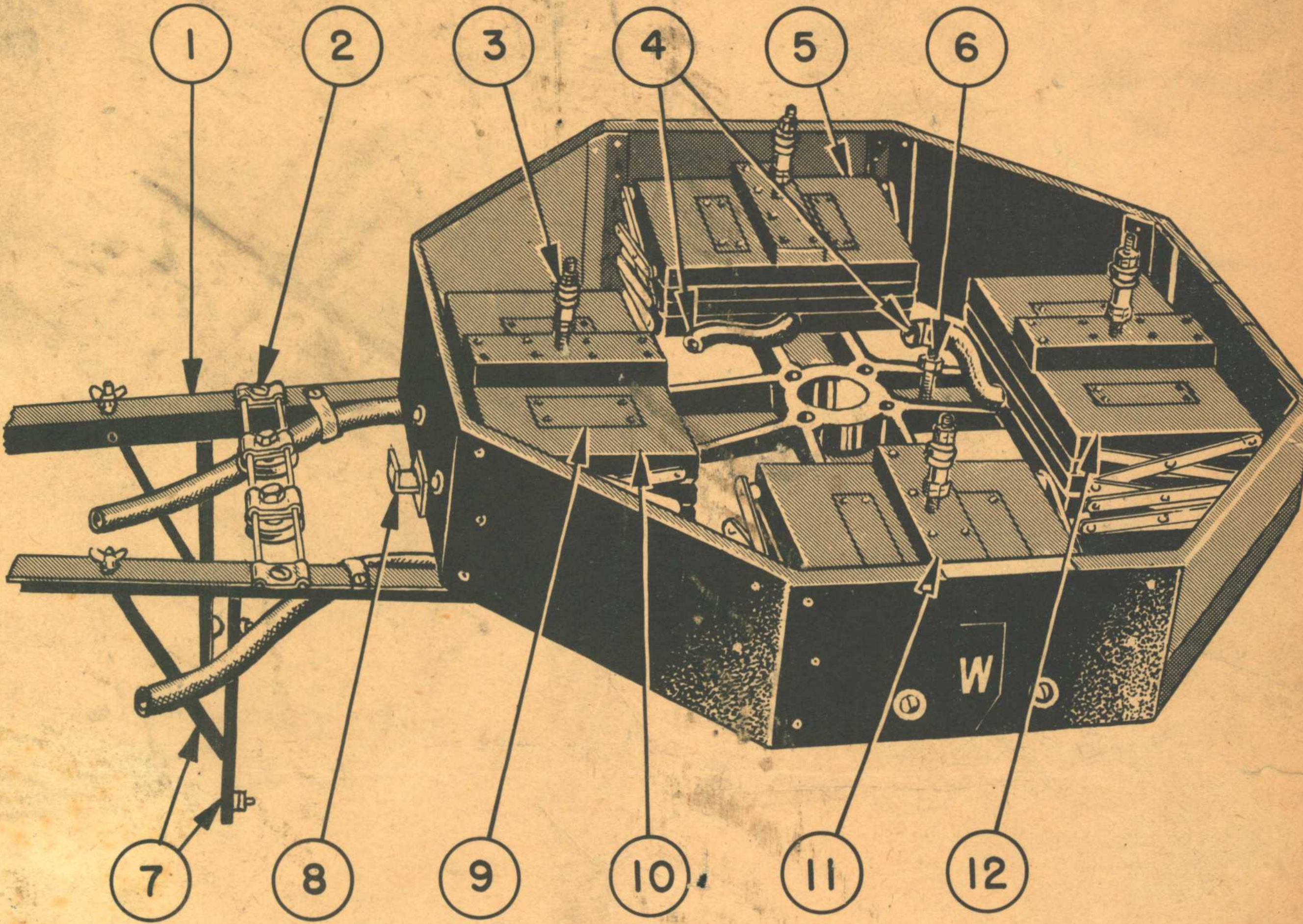


Figure 79—Revolving Octagon

1. *Angle Iron Supports for Turning Motor*
2. *Belt Tightener*
3. *Bellows Bolts*
4. *Bellows Hose Connections*
5. *Right Banking Bellows*
6. *Octagon Cross*
7. *Turning Motor Bracket*
8. *Simulated Gyro Operating Slide*
9. *Bellows Flap Valve*
10. *Front Pitching Bellows*
11. *Left Banking Bellows*
12. *Rear Pitching Bellows*

(4) MAIN BELLOWS.

(*a*) Remove the four main bellows from the revolving octagon by turning the octagon completely over and putting it on sawhorses or blocks, high enough to prevent the bellows studs from touching the floor.

(*b*) Remove the four wood screws from each bellows.

Note

If the hose are left connected to the bellows, tag each bellows to facilitate proper reassembly.

k. BASE.

(1) SHEAVE.—Detach the base sheave by removing four machine screws holding it to the base cross.

(2) SIMULATED GYRO TAKE-OFF ASSEMBLY. (*See figure 8'.*)

(*a*) Disconnect the operating arm from the take-off assembly.

(*b*) Loosen the two setscrews holding the take-off assembly to the hollow shaft and lift the assembly straight up until it clears the spindle and wiring.

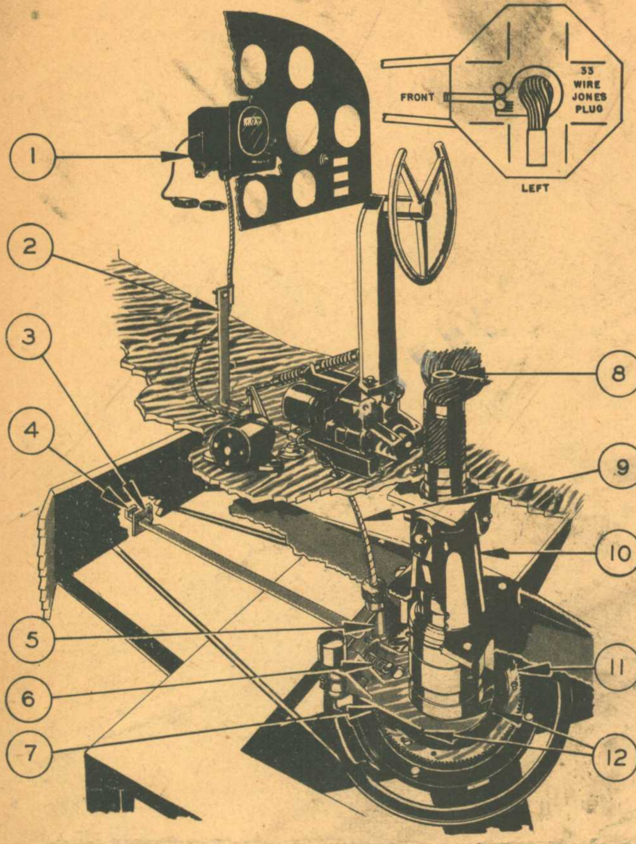


Figure 80—Simulated Directional Gyro

1. *Simulated Directional Gyro*
2. *Flexible Shaft Bracket*
3. *Operating Slide Plate*
4. *Operating Slide*
5. *Take-Off Operating Arm and Gear*
6. *Take-Off Operating Arm Spring*
7. *Take-Off Bracket*
8. *Main Spindle*
9. *Directional Gyro Flexible Shaft*
10. *Universal Joint*
11. *Gyro Gear Attached to Bearing Housing*
12. *Setscrews*

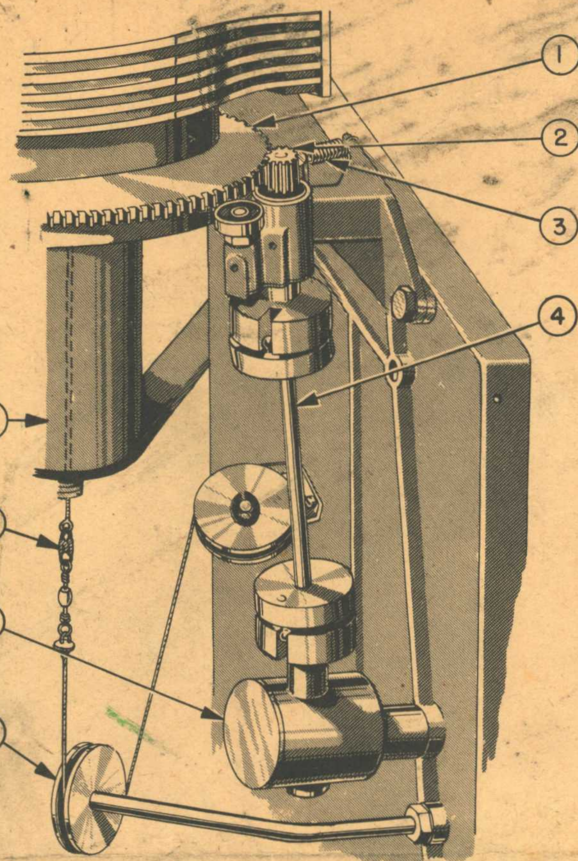


Figure 81—Wind Drift Take-Off Gear

1. *Collector Ring Gear*
2. *Wind Drift Driving Gear*
3. *Coil Spring*
4. *Coupling*
5. *Transfer Elbow*
6. *Throttle Cable Swivel Clamp*
7. *Right Angle Drive Wind Drift Shaft*
8. *Throttle Cable Pulley on End of Wind Drift Mechanism*

(3) WIND DRIFT MECHANISM. (*See figure* 81.)

(*a*) Disengage the wind drift driving gear from the gear at the base of the collector ring assembly. Unhook the retaining spring and swing the gear assembly out of mesh.

(*b*) Either remove the drive link from the assembly or secure it to the assembly with string or rubber bands, otherwise the drive may drop out.

(*c*) Disconnect the electric leads, remove the mounting screws in the base flanges of the outer case, and lift the mechanism from the trainer base.

(4) AUTOMATIC RADIO COMPASS TAKE-OFF UNIT. (*See figure* 5.)

(*a*) Disconnect the wiring from the terminal strip.

(*b*) Remove the two capscrews from the bracket attached to the bearing housing assembly.

(5) VACUUM TURBINE. (*See figure* 4.)

(*a*) Disconnect the cable from the base terminal box.

(*b*) Remove the clamp securing the cable to the trainer base.

(*c*) Remove the turbine mounting bolts.

(*d*) Remove the turbine and motor as a unit.

(6) BASE TERMINAL BOX. (*See figure* 4.)

(*a*) Remove the cable clip from the base cross.

(*b*) Remove the two capscrews holding the collector ring brush assembly bracket to the bearing housing.

(*c*) Disconnect electric connections.

(*d*) Block up or hold the terminal box and remove the four mounting nuts inside the box.

(*e*) Take out the base terminal box.

(7) TELEGON OSCILLATOR. (*See figure* 4.)

(*a*) Remove the four metal screws holding the cover and oscillator to the base frame.

(*b*) Remove the oscillator by sliding it toward the center of the base.

(*c*) Remove the three wood screws holding the oscillator case to the base and remove the oscillator.

(8) BEARING HOUSING AND SPINDLE ASSEMBLY.—Remove four capscrews holding the bearing housing to the octagon cross and lift out the housing and spindle as a unit. (See figure 4.)

CAUTION

Care should be taken in removing spindle not to damage the collector rings.

l. OPERATOR'S DESK.—See that the flexible shafts to the wind-drift controls on the right end of the desk have been disconnected. Disconnect the plug from the top of the automatic recorder. Disconnect the plugs from the rear of the radio compass control box and from the rear of the remote instrument control box. Label or tag the plugs to facilitate reassembly. (See figure 6.)

(1) DESK JUNCTION BOX.

(*a*) Remove the four screws attaching the desk junction box to the back of the desk.

(*b*) Pull the cables and plugs that were connected to the remote instrument box and to the radio compass control box out through the holes in the back of the desk.

(*c*) Move the junction box to the front of the desk as far as the cable carrying the automatic recorder plug will permit the plug to rise against the lower end of the conduit extending out over the top of the desk.

Note

The desk junction box may be given a thorough cleaning and inspection, and parts or wiring may be replaced from this position. If necessary to remove the desk junction box to a greater distance for a more complete disassembly and overhaul, it will be necessary to disconnect the recorder cable terminals in the desk junction box.

(2) RADIO.—Disconnect the plug at the rear of the radio chassis and lift the chassis out of the desk drawer.

(3) REMOTE INSTRUMENTS. (*See figures* 70 *and* 71.)

(*a*) Remove the rear panel of the remote instrument control box and disconnect the individual instrument cables and the leads to the vibrator motor.

Note

The leads to the vibrator motor are disconnected by unsoldering connections. Label the leads to facilitate reassembly.

(*b*) Remove the six Phillips head mounting screws from the panel and lift out the panel with the instruments still installed.

(*c*) Remove the vibrator motor and its mounting bracket from the panel as a unit.

(*d*) Remove the instruments from the panel. The air-speed indicator, vertical-speed indicator, and landing instrument are mounted with four Phillips head machine screws each, while the altimeter is mounted with three Phillips head screws.

(4) AUTOMATIC RADIO COMPASS DESK UNIT. (*See figure* 82.)

(*a*) Lift out the rear panel and remove the two screws holding the cable plug to the support bracket.

(*b*) Remove the four screws from the front panel and remove the unit through the front of the cabinet.

(5) WIND-DRIFT CONTROL UNIT.

(*a*) Remove the wind-drift control unit from the right-hand end of the desk by taking out five machine mounting screws.

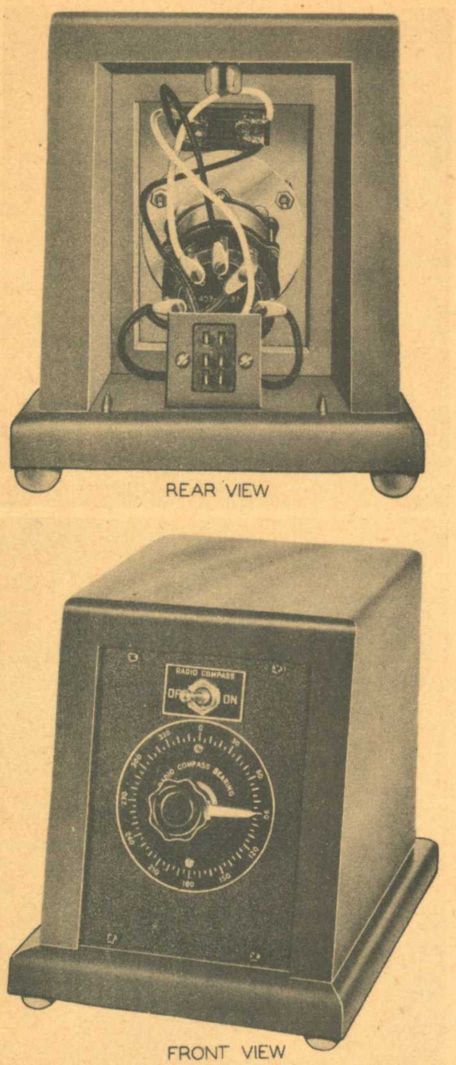


Figure 82—Automatic Radio Compass—Operator's Desk Unit

3. DETAILED DISASSEMBLY, CLEANING, INSPECTION, TESTING, AND REPAIR.

Note

The following instructions for detailed disassembly are based on the assumption that the units involved have been previously removed from the trainer. Should it become necessary at any time to remove individual units from the trainer for repair or replacement, such units should be removed in accordance with instructions contained in paragraph 2 of this section and replaced in accordance with instructions contained in paragraph 5 of this section.

a. INSTRUMENTS.

(1) Detailed instructions for disassembly, cleaning, inspection, testing, repair, and reassembly of the following instruments are contained in AN 08-25A-1—Handbook of Link Trainer Instruments with Parts Catalog (Kollsman).

(*a*) Manifold Pressure Indicator

(*b*) Tachometer

(*c*) Air-Speed Indicator

(*d*) Altimeter

(*e*) Vertical-Speed Indicator

(*f*) Automatic Radio Compass

(*g*) Magnetic Compass

(*h*) Fuel Gage

(2) Detailed instructions for disassembly, cleaning, inspection, testing, repair, and reassembly of the directional gyro are contained in T.O. No. 05-20-10—Handbook of Instructions with Parts Catalog, Directional Gyro Indicator (Sperry).

(3) Detailed instructions for disassembly, cleaning, inspection, testing, repair, and reassembly of the simulated directional gyro are contained in AN 28-5A-1—Handbook of Instructions with Parts Catalog for the Simulated Directional Gyro (Link).

(4) Detailed instructions for disassembly, cleaning, inspection, testing, repair, and reassembly of the turn and bank indicator are contained in AN 08-25A-7—Handbook of Instructions with Parts Catalog for Turn and Bank Indicators, Types 1705-2T-A2, 1705-2AA-A2, and 1705-2AA-B2 (Pioneer) and T.O. No. 05-20-7—Handbook of Instructions with Parts Catalog, Link Trainer Turn and Bank Indicator, Type 1716-2N-A2 (Pioneer).

(5) Detailed instructions for disassembly, cleaning, inspection, testing, repair, and reassembly of the artificial horizon are contained in AN 28-5-4—Handbook of Instructions with Parts Catalog, Artificial Horizon Indicator (Link).

(6) Detailed instructions for disassembly, cleaning, inspection, testing, repair, and reassembly of the standard beam approach indicator (flight path) are contained in AN 28-5-5—Handbook of Instructions with Parts Catalog, Standard Beam Approach Indicator (Flight Path) Type No. 1 (Link).

(7) Detailed instructions for disassembly, cleaning, inspection, testing, repair, and reassembly of the clock used in the trainer are contained in

T.O. No. 05-1-9—Handbook of Instructions with Parts Catalog, Aircraft Clocks.

CAUTION

Due to the nature of the mechanisms involved, repair or overhaul of the trainer instruments should be accomplished only by qualified instrument repair men.

b. VALVES.

(1) AILERON VALVE. (*See figure* 83.)

(*a*) DISASSEMBLY.—Release the set collar and lift off the top section and center leaf section.

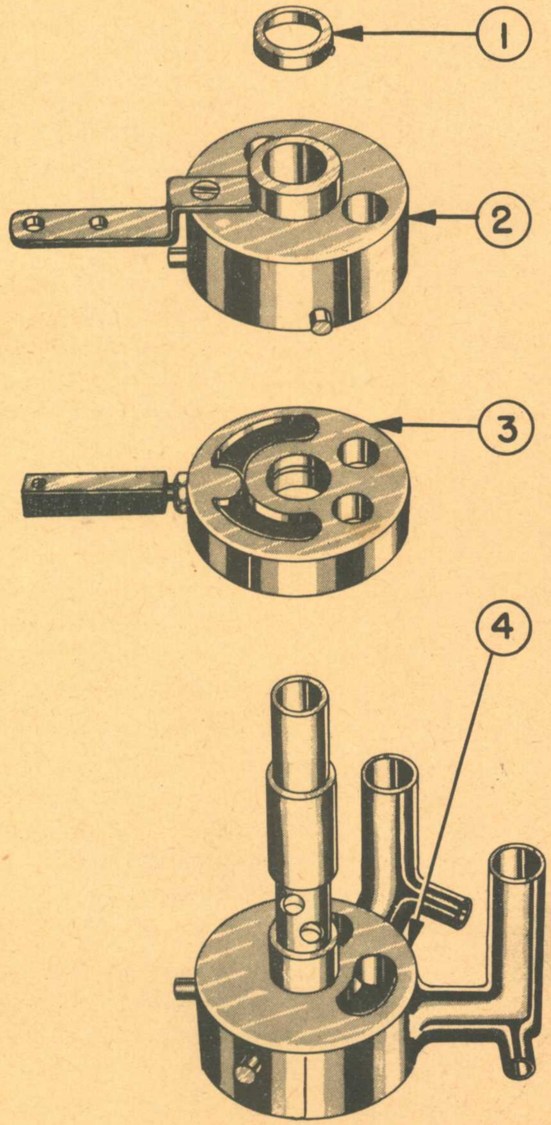


Figure 83—Aileron Valve (Exploded View)

1. Set Collar
2. Top Section
3. Center Leaf Section
4. Main Valve Body

(*b*) CLEANING, INSPECTION, TESTING, AND REPAIR.

1. The aileron valve seldom requires replacement because of operating wear. Inspect the valve faces carefully for imperfections due to wear which may interfere with normal operation.

2. A visual inspection will generally uncover defects in the valve face but, if doubt exists, it is better to give the valve a light lapping than to assume that no correction is needed.

3. Lapping is done with ordinary automobile valve lapping compound in the following manner:

a. Spread a thin coat of lapping compound on the face of the main valve body and slide the center leaf section back into position. Holding the main body section in one hand, rotate the center leaf section about its shaft, at the same time exerting sufficient pressure to accomplish the lapping process.

CAUTION

The lapping procedure should not be carried beyond the point necessary to remove the imperfections.

b. Remove the center leaf section, wipe off the compound, thoroughly wash with clean water, and replace the section. Spread a thin coat

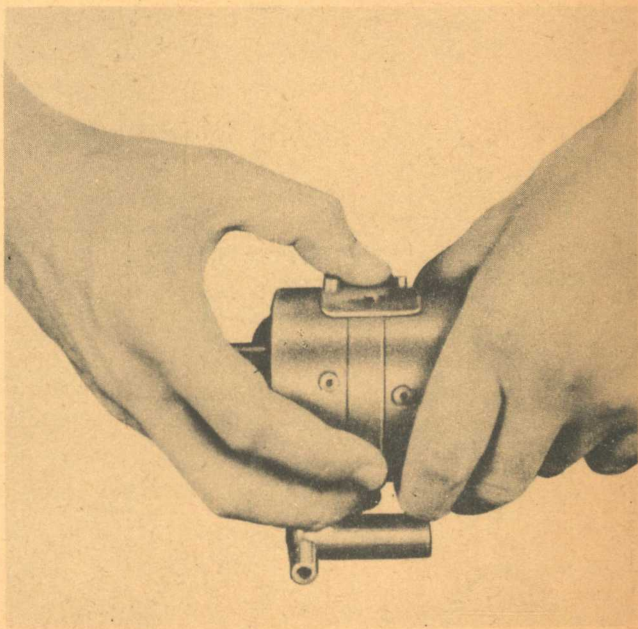


Figure 84—Aileron Valve—Lapping In Top Section

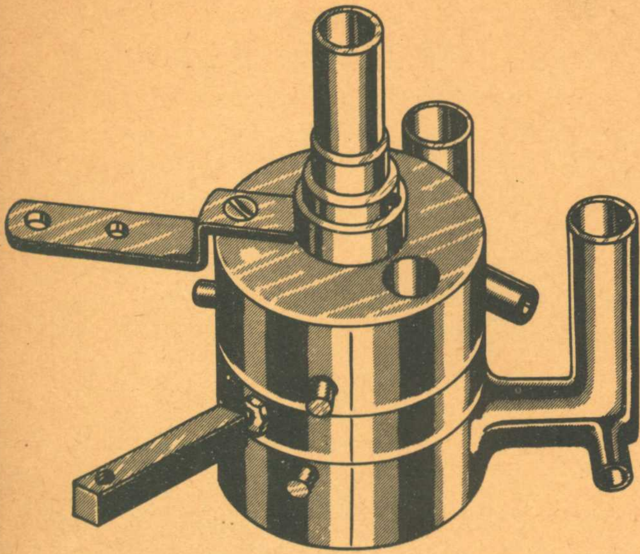


Figure 85—Aileron Valve—Assembled

of compound on the exposed face of the center leaf section, hold the main body and the center leaf section firmly, replace the top section, rotate it about its shaft, exerting pressure on the faces being lapped. (See figure 84.)

c. Remove the top section and the center leaf section and thoroughly wash off the lapping compound from all parts of the valve with clean water.

(*c*) REASSEMBLY.—Reassemble the valve sections, securing them in position with the set collar.

CAUTION

In the final reassembly of the aileron valve, make sure the sections are placed so the index marks line up at some point during the limited travel of the valve sections. (See figure 85.)

(2) RUDDER VALVE. (*See figure* 17.)

(*a*) DISASSEMBLY. — To separate the halves, simply lift off the top section.

(*b*) CLEANING, INSPECTION, TESTING, AND REPAIR.

1. The rudder valve, like the aileron valve, seldom requires replacement, but the valve faces may require lapping. The rudder valve has only two sections; the bottom section is fixed, and the top section rotates and may be lifted off.

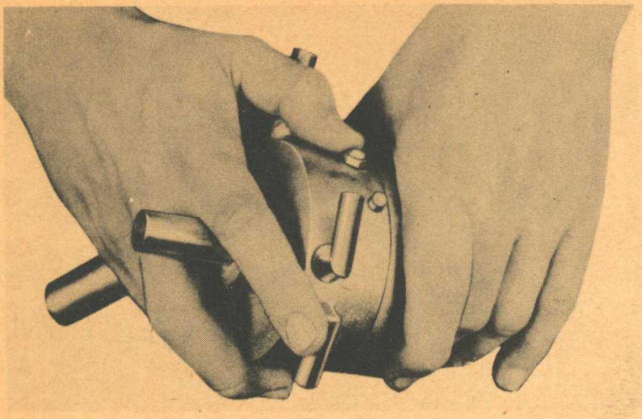


Figure 86—Rudder Valve—Lapping In

2. Remove the compass deflector switch arm by taking out two screws.

3. Spread lapping compound on one valve face, place the two sections back together and, holding the lower section firmly in one hand, rotate the top section about its shaft with a moderate amount of pressure until the valve faces are smooth. (See figure 86.)

4. Separate the sections, clean off all lapping compound, wash thoroughly with clean water, and see that all valve passages are clean.

(*c*) REASSEMBLY.—Reassemble the compass deflector switch arm to the top half of the valve. Be sure the two halves are put together so that the center of movement between the two stops brings the compass deflector switch arm in the center of the switch contacts.

(3) ELEVATOR VALVE. (*See figure* 16.)

(*a*) DISASSEMBLY.—Disassembly is accomplished by removing the set collar and lifting the top half of the valve off the valve shaft.

(*b*) CLEANING, INSPECTION, TESTING, AND REPAIR.

1. The elevator valve, like the rudder and aileron valves, seldom requires replacement, but its faces may require lapping.

2. Spread lapping compound on the lower valve face, replace the top half, and lap the faces together by rotating the upper half of the valve on its shaft.

3. Remove the top half of the valve. Clean off the lapping compound, wash thoroughly with clean water, and make sure that all valve passages are clean.

4. Place the climb valve in a vise, insert the valve seat in the limit valve end and draw it down tight.

5. Insert the limit valve assembly 3/4 of the way, put a very small amount of threadlube, Specification No. AN-C-53, on the last few threads, spread it around the circumference of the threads, and draw the limit valve down tight.

6. Remount the valve body to the mounting bracket with U-bolts, lock washers, and nuts.

7. Insert the dive valve needle (left-hand thread) and screw it in about 3/4 of its threaded travel. Lock tightly with the clamp nut (12).

8. Insert the climb valve needle (right-hand thread) and screw it in about 3/4 of its threaded travel. Lock tightly with the clamp nut.

9. Remount the control arm assembly and secure it in position by tightening the screws (2).

10. Remount the cleaned filter to the dive valve.

Note

After reassembly and remounting on the bracket, the climb-dive valve should be stored until the trainer has been reassembled to a point where a supply of vacuum is available for testing purposes.

(*d*) TESTING AND ADJUSTMENT.

1. These valves handle very small quantities of air and their proper functioning depends upon the adjustments being made very exactly.

2. Each valve has two adjustments. The clamp nut should be adjusted to take up any looseness or wear in the threads and the lever arm on the needle should be adjusted so that when the arm is against the stop, the needle valve will be closed without the needle being jammed into the valve seat.

3. ADJUSTING FOR WEAR IN THREADS.—If side play can be felt in the valve needle, the clamp nut should be drawn up slightly. (Care must be taken to avoid over-tightening.) The clamp nut should be tightened one-sixth of a turn at a time and the valve tested after each one-sixth turn to make sure it does not bind. To make this test, swing the control arm away from the stop and let go of it to see whether the compensator spring promptly returns the arm to the stop. Continue tightening the nut, testing for bind at each one-sixth turn. When tightened enough so the spring does not promptly close the valve, loosen the nut just enough to stop the binding.

4. ADJUSTING NEEDLE VALVES AND TESTING FOR LEAKAGE. (*See figure* 88.)

a. To test the climb-dive needle valves: remove the air filter from the elbow on top of the dive valve, provide a flexible tubing connection from the vacuum supply that can be attached to the elbow on the top of either the climb or the dive valve, free the end connections of the valves so they may be readily connected to a vacuum gage. Connect, test, and make final adjustments of one valve before proceeding with the other.

b. See that a vacuum gage or manometer is tightly fitted to the end fitting of the valve.

WARNING

The connection between the valve and the vacuum gage must be absolutely airtight. Any leak in this line would give the appearance of a leak in the valve and, in attempting to close the valve enough to prevent the leak, the needle would be forced against the valve seat and the valve ruined.

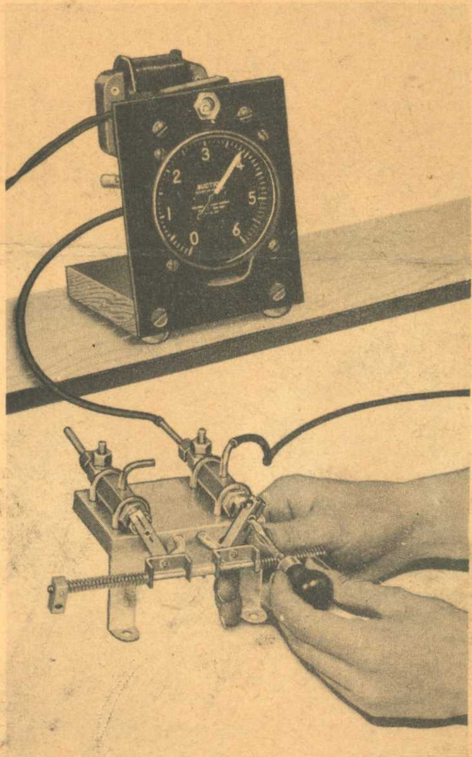


Figure 88—Adjusting Climb-Dive Valve

c. Loosen the control arm screw enough so that it will be holding only slightly.

d. Place a 1/32-inch spacer, or thickness gage (feeler gage or any object 1/32 of an inch thick) between the lever arm and the stop.

e. Connect one end of a 3/16-inch rubber tube to any convenient source of vacuum in the trainer and the other end to the elbow fitting on the top of the valve and note the *rate* at which the vacuum gage moves to its maximum reading.

f. Remove the tubing from the elbow, and open the valve to allow the vacuum gage to return to zero; then, allow the valve to close (arm against stop).

g. Hold the vacuum line *against* the elbow so that the vacuum gage shows two or three inches of mercury, yet so there is a slight leak between the rubber tube and the elbow.

h. Place the 1/32-inch spacer between the arm and the stop, and clamp or otherwise prevent the arm from moving.

i. With a small screw driver, turn the needle about 1/100 of a revolution in the direction of closing, being careful *not* to entirely cut off the flow to the vacuum gage.

CAUTION

The dive valve needle has a left-hand thread.

j. Vary the amount of leak between the rubber tubing and the elbow and note the *rate* of movement of the vacuum gage.

k. Continue carefully screwing the needle in, a very little at a time, meanwhile varying the leak between the tube and the elbow until the movements of the gage become sluggish. When this point is reached, the rubber tubing should be entirely removed from the elbow to allow the gage to return to zero, and then firmly attached to the elbow at each test.

l. When the needle is in far enough so that the full force of the vacuum only moves the gage slowly, tighten the lever arm clamp screw slightly and remove the 1/32-inch spacer and allow the arm to move against the stop. (To return the gage to zero, remove the tubing and open the valve for a moment. Then replace the tubing.)

m. If the flow of air has been reduced sufficiently with the spacer in place, it will now be entirely cut off and the gage will remain at zero.

n. If the vacuum gage indicates a leak and the valve needle cannot be adjusted, the needle must be replaced.

o. If, however, there is still a small leak, replace the 1/32-inch spacer and, proceeding as before, *reduce* the amount of leak. To do this, screw in *very slightly* on the needle. With the spacer in place, there still *must continue to be a slight leak.* Then, remove the spacer and test as before.

p. The final adjustment must be one that shows a leak with the spacer in place and no leak when the spacer is removed and the arm is against the stop.

Note

If the valves have been in use for several hundred hours, a 3/64-inch spacer may be used when making this adjustment.

q. If the needle has been removed, it should be given a thin coat of light oil, Specification No. AN-0-6, before starting in the threads. Connect the vacuum gage to the end of the valve and, holding the tubing against the elbow, vary the leak and screw the needle in with the fingers until the movement of the gage becomes sluggish. Then replace the lever arm and compensator and proceed to adjust the needle.

r. Replace the climb-dive valve assembly in the trainer and connect the tubing.

(6) STALL VALVE. (*See figure* 89.)

(*a*) DISASSEMBLY.—To disassemble the stall valve for repair or overhaul, proceed as follows:

1. Loosen the small setscrew at the base of the pendulum and remove the pendulum.

2. Remove the clamping nut from the end of the valve.

3. Remove the valve needle, turning it clockwise (threads are left-handed) and store it in a safe, clean place.

4. Place the base of the valve assembly in a vise and remove the right-angle pipe fitting from the end of the valve body.

5. Remove the valve seat clamp screw from the valve body with a small screw driver.

6. Remove the valve seat by pushing it out of the valve body.

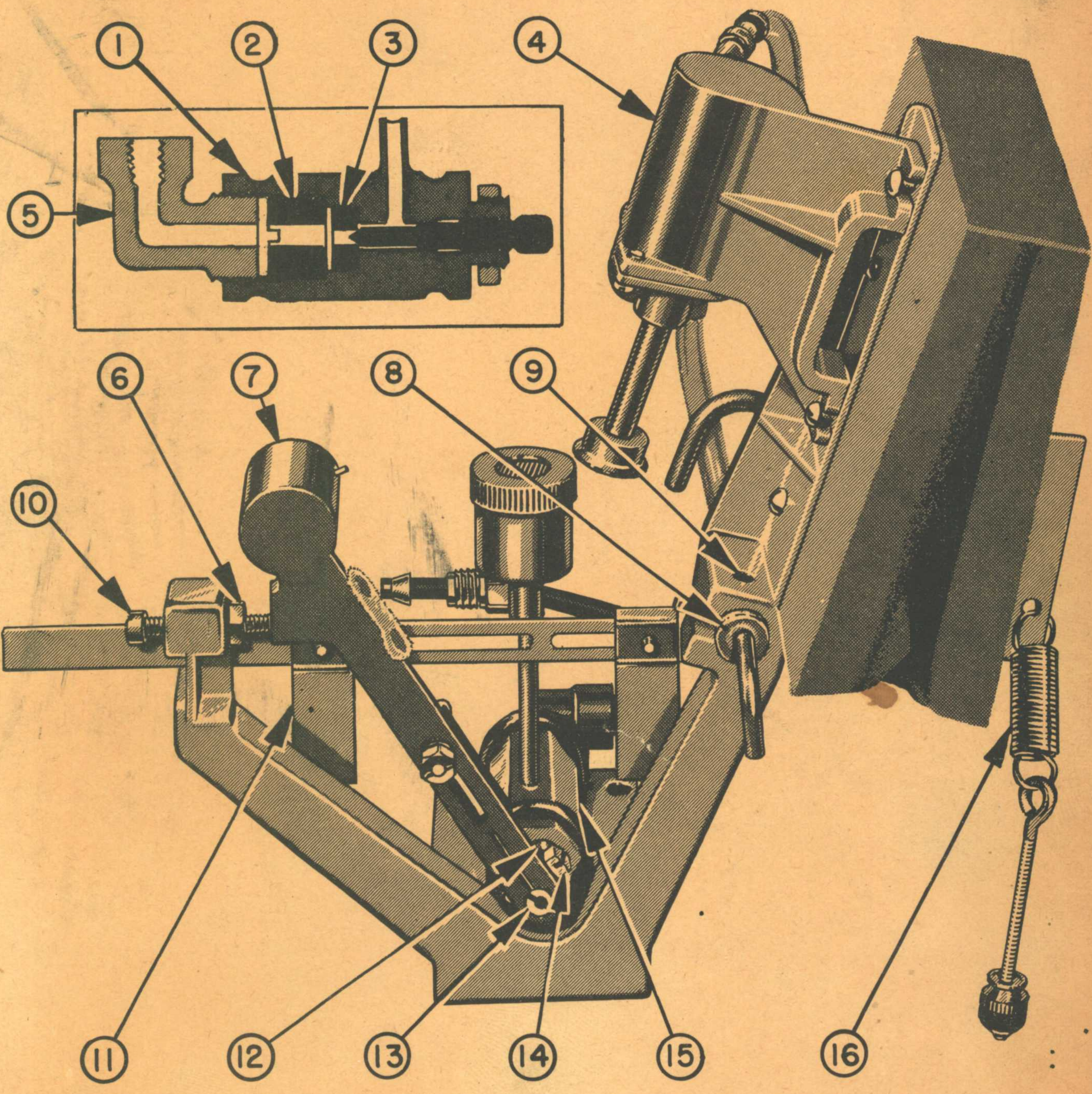


Figure 89—Stall Valve

1. *Valve Body (Section)*
2. *Valve Seat Clamp Screw*
3. *Valve Seat*
4. *Anti-Spin Valve*
5. *Right Angle Pipe Fitting*
6. *Stop Screw Lock Nut*
7. *Pendulum*
8. *Jet Assembly*
9. *Jet Assembly Setscrew*
10. *Stop Screw*
11. *Recovery Pin*
12. *Clamping Nut*
13. *Needle*
14. *Pendulum Setscrew*
15. *Valve Body*
16. *Spring*

(*b*) CLEANING AND INSPECTION.—Clean the needle, valve seat and valve body thoroughly. Inspect all parts, especially the valve seat, for wear or damage. Wear or damage to the needle seldom occurs as it is specially hardened. However, if the needle has been jammed into the valve seat, the valve seat will probably be damaged and a new one will have to be installed.

(*c*) REASSEMBLY.—To reassemble the stall valve proceed as follows:

1. Place the valve seat in the valve body with the polished surface and beveled edge towards the pendulum end of the valve. Use a toothpick or similar instrument to keep the valve seat from turning over when it is pushed into the valve body.

2. Screw the valve seat clamp screw into the valve body and tighten.

3. Spread a thin coat of threadlube, Specification No. AN-C-53, on the threaded part of the elbow fitting and screw it in place.

4. Spread a thin coat of instrument oil, Specification No. AN-0-6, on the valve needle and start it in the threads.

5. Screw the needle in slowly (do not use a screw driver) until it barely touches the valve seat; then, back the needle off one-sixth of a turn.

6. Install the clamping nut but do not tighten it.

7. Adjust the stopscrew on the stall valve bracket until there is 3/8 of an inch between the end of the screw and the inside of the bracket edge.

8. Install the pendulum on the end of the valve needle and, with the pendulum placed against the adjustable stopscrew, tighten the setscrew at the base of the pendulum.

9. Tighten the clamping nut until the pendulum has a tendency to bind when it is moved back and forth; then, back off the clamping nut until the pendulum moves freely.

(*d*) DISASSEMBLY AND CLEANING OF THE THREE-WAY JET ASSEMBLY.

1. If the restriction in the three-way jet assembly becomes clogged with dust or other foreign matter, vacuum will be unable to act on the line to the spin trip bellows and the trainer will not spin.

2. To remove the three-way jet assembly for cleaning, disconnect the tubing from both end fittings, loosen the setscrew, and remove the assembly from the stall valve bracket.

3. Clean the three-way jet assembly by inserting a wire less than .025 inches in diameter in the straight end fitting through the restriction. The dust or foreign matter thus loosened may be blown out of the jet assembly.

Note

If the trainer has been operating for a long period of time in a smoky or dusty room, the restriction may become so badly clogged that it will be necessary to soak the jet assembly in carbon tetrachloride to remove the accumulation of dust and tar.

4. Replace the jet assembly and tighten the setscrew.

(*e*) ANTI-SPIN VALVE—DISASSEMBLY, INSPECTION, AND CLEANING.

1. Remove the two screws from the lower end of the anti-spin valve cylinder, allowing the cylinder head and plunger to drop out.

2. Clean the cylinder, plunger, and stem, and coat with instrument oil, Specification No. AN-0-6.

3. Reassemble the plunger and cylinder head and insert the two screws.

4. Remove the bleed hole filter from the vacuum line to the jet assembly, clean, repack, and reassemble. (Refer to paragraph 3*r*(2), of this section.)

Note

The anti-spin valve mechanism on the stall valve is standard equipment on all instrument flying trainers AN-2550-1, beginning with Link Serial No. 7501.

Note

After reassembly, the stall valve should be stored until such time as the trainer has been reassembled sufficiently to provide a supply of vacuum for testing purposes.

(*f*) TESTING AND ADJUSTING.

1. The stall valve has two adjustments:

a. A clamping nut to take up any wear or looseness in the threads.

b. An adjustable stopscrew for positioning the pendulum so that the needle just barely touches the valve seat when the valve is in the closed position.

2. If side play can be felt in the stall valve needle, due to wear or looseness in the threads, tighten the clamping nut until the pendulum has a tendency to bind; then, back it off just enough to stop the binding.

Note

The pendulum must move freely through its full travel.

3. Before making any adjustment of the stall valve needle, test the valve for leakage, using a manometer or vacuum gage capable of measuring up to 5 in. Hg. To test for leakage proceed as follows:

a. Disconnect the line which comes from the climb-dive tank at the elbow fitting on the stall valve and attach the vacuum gage by means of tubing to this fitting.

b. Remove the air filter from its fitting in the center of the stall valve by giving it an upward pull. Attach one end of a length of 3/16-inch tubing to this fitting, connecting the other end to any source of vacuum in the trainer.

WARNING

The connection between the valve and the vacuum gage must be absolutely airtight, as a leak here will give the same kind of indication on the gage as a leak in the valve. The setscrew connecting the pendulum to the end of the valve should be tight; otherwise, movement of the pendulum will not affect the position of the needle.

c. Move the pendulum away from the stopscrew until 3-1/2 to 4 inches of vacuum is registered on the gage.

d. Then, move the pendulum back against the stopscrew and disconnect the vacuum supply line. If the gage reading does not remain constant, there is a leak in the valve and the needle requires adjustment.

4. To adjust the needle, proceed as follows:

a. Loosen the lock nut on the adjustable stopscrew and turn the screw counterclockwise a little at a time, checking the gage after each adjustment until no leak is indicated.

b. At this point the valve needle should be barely touching the valve seat, without jamming into it, and the pendulum should be resting against the adjustable stopscrew.

c. Vacuum may have to be applied to the valve several times until an adjustment is reached where the gage does not indicate a leak.

WARNING

If the adjustable stopscrew is turned back too far, the pendulum will jam the needle into the valve seat, in which case the valve seat will be damaged and a new one will have to be installed. Although the valve will not leak in the closed position, if the needle has been jammed into the valve seat, it will not give a correct indication of "mush" or stalling speed, as the valve seat will be flanged out.

d. When the vacuum gage indicates no leakage and the pendulum rests against the adjustable stopscrew, without jamming the needle into the valve seat, tighten the lock nut on the adjustable stopscrew.

e. Recheck the valve for leakage, as tightening the lock nut may have changed the position of the adjustable stopscrew.

5. If an adjustment cannot be made, so that the gage indicates no leakage when the pendulum is resting against the adjustable stopscrew, the stall valve assembly will have to be disassembled and new parts installed.

(7) DIRECTIONAL GYRO AND TURN AND BANK INDICATOR SHUT-OFF VALVES. (*See figure* 44.)

(*a*) DISASSEMBLY.—Loosen the setscrews in the retaining collars; remove the collars and the top sections of the valves.

(*b*) CLEANING, INSPECTION, TESTING, AND REPAIR.—These shut-off valves seldom require attention other than thorough cleaning and oiling. The surfaces of the two valves are polished and only a very small amount of oil is required. Do not attempt to correct any leakage by lapping in with valve grinding compound as this will destroy the valve face. Inspect the operating levers and flat rods that extend through the plate

on the outside of the fuselage to see they are not bent. Apply a drop of instrument oil, Specification No. AN-0-6, to the operating lever joint. If the valve is defective, a new one should be installed.

(*c*) REASSEMBLY. — Replace the top halves and retaining collars, holding them down firmly as the setscrews are tightened.

c. ROUGH AIR GENERATOR. (*See figure* 90.)

(1) CLEANING, INSPECTION, TESTING, AND REPAIR.

(*a*) Remove dust from the unit with compressed air or a soft brush.

(*b*) Inspect the flap valves for alignment, condition of chamois pads, and metal cam bumper plates.

(*c*) Inspect hair springs and wire guides for tightness and alignment.

(*d*) Inspect the cams for tightness and correct spacing on the cam shaft. End play in the cam shaft may be from .002 to .004 of an inch.

(*e*) Inspect the cams for proper timing.

1. Cam (5) and cam (6) (rudder cams), as shown in figure 90, hold their respective flap valves open at all times when not operating, as opposed to cams (1), (2), (3), and (4), which leave their respective flap valves in a closed position when not operating.

2. Cams (1) to (6) should be arranged on the cam shaft so that when the shaft is rotated in the direction of the arrow (figure 90), the flap valves for cams (1), (2), (3), and (4) will open, and the flap valves for cams (5) and (6) will close in the following order, from left to right: (A), (F), (C), (B), (E), and (D).

3. The point of contact on each pair of cams, (1) and (2), (3) and (4), and (5) and (6), will be approximately opposite each other. Cams (1) and (2) will be approximately 60 degrees in advance of cams (5) and (6). Cams (5) and (6) will be approximately 60 degrees in advance of cams (3) and (4).

4. To test the timing of the cams, turn the shaft slowly and see that, as flap valve (A) closes, flap valve (F) is just about to operate, that is, close; that as valve (F) opens, valve (C) is just about to open; as (C) closes, (B) is just about to open; as (B) closes, (E) is just about to operate, that is, close; that as (E) opens, (D) is just about to open; and that as (D) closes, (A) is just about to open. There should be less than 1/8-inch of cam movement between the closing of one valve and the opening of the next.

(*f*) The lock nuts on the rough air generator crank should be so placed that when the crank is turned to its extreme downward position, and the rough air generator is out of operation, the clearance between the cams and bumper plates on the flap valves will be about 1/8-inch. When the crank is turned completely up, flap valves (A), (B), (C), and (D) should open 3/16 of an inch when engaged by their respective cams. The crank should turn freely in the crank housing. If it is too tight, open the slot in the end of the housing with a thin bladed screw driver used as a wedge; if too loose, close the slot slightly with heavy pliers.

(*g*) The adjustable plate and spring-controlled pin, which governs the position of the valve block, should be so placed as to hold flap valves (E) and (F) open 3/16 of an inch when the crank is up and the cams are engaging the valves. Adjustment of the valve block should also be such that the cams do not strike the hair springs as they revolve.

(*h*) The valve adjusting plate and valve lifting pin should be so placed as to hold flap valves (E) and (F) open 3/16-inch when the crank is turned on or all the way in, and they are being engaged by cams (5) and (6).

(2) REASSEMBLY.—Store the rough air generator in a clean place until a point in the reassembly of the trainer is reached where it can be conveniently mounted in the fuselage. (Refer to Section IV, paragraph 5*e*(15).)

d. SLIP-STREAM SIMULATORS. (*See figure* 14.)

(1) The slip-stream simulators seldom require more than adjustment and filling with a hydraulic fluid, Specification No. 3580. If a jerky action in the lever cannot be overcome by adjustment of resistance nut (4), or if in any other manner the simulator is found defective, a new unit should be installed.

(2) Adjustments to increase or decrease stiffness or resistance of the simulators are made by turning the nut (4) clockwise to increase resistance, and counterclockwise to decrease resistance. The

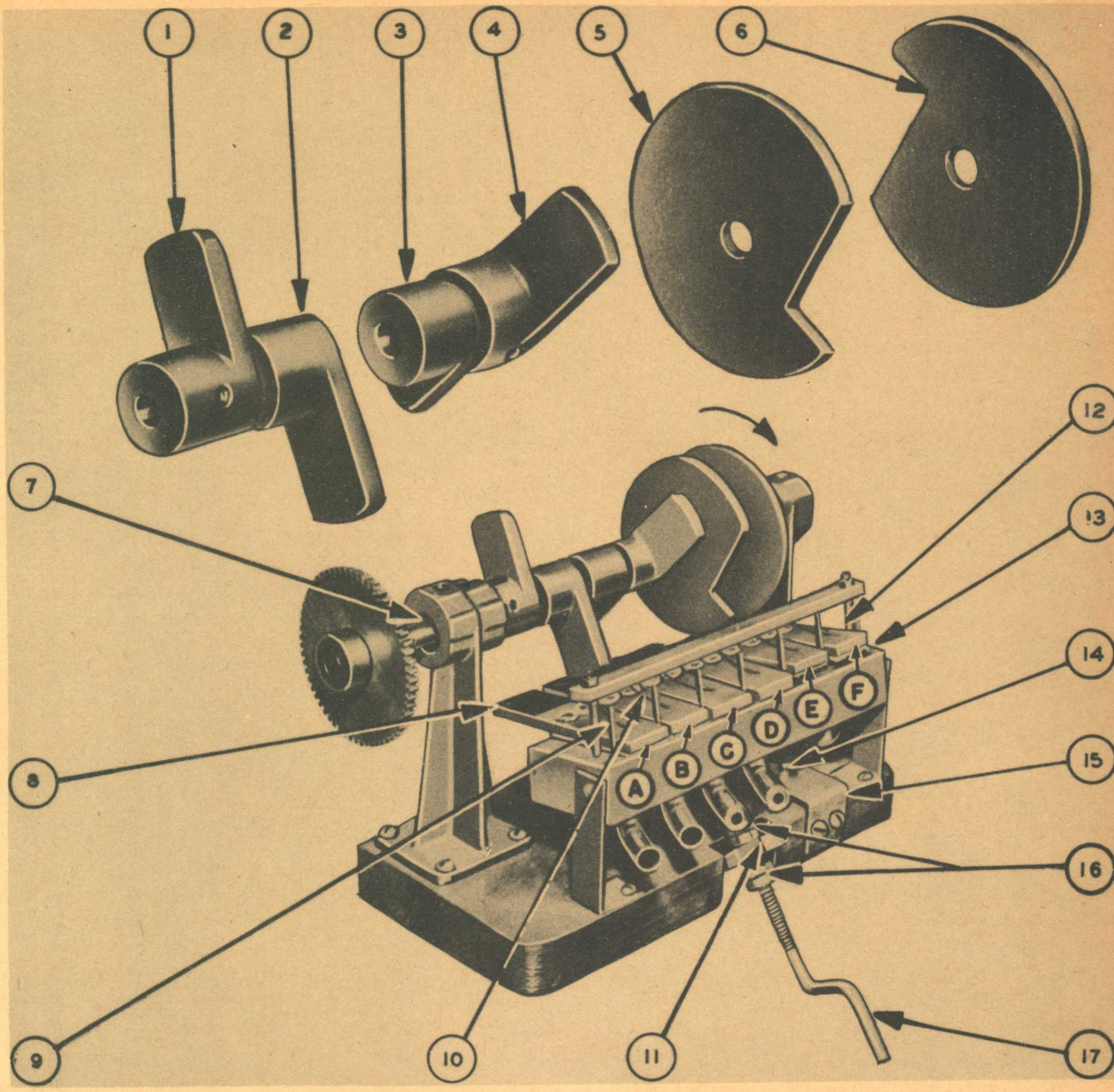


Figure 90—Rough Air Generator

1. *Aileron Cam*
2. *Aileron Cam*
3. *Elevator Cam*
4. *Elevator Cam*
5. *Rudder Cam*
6. *Rudder Cam*
7. *Cam Shaft*
8. *Bumper Plates*
9. *Guides*
10. *Springs*
11. *Crank Housing Slot*
12. *Flap Valve*
13. *Chamois Pad*
14. *Adjusting Pin*
15. *Adjusting Plate*
16. *Locking Nuts*
17. *Crank*

packing nut (3) is loosened to make adjustments and tightened to hold adjustments.

Note

If the packing nut (3) is too tight, it will cause a jerky action of the simulator arm. It should be just tight enough to prevent leakage at the shaft end.

(*a*) Fluid is added to the simulator at the filler hole (1). The fluid should be no higher than

the bottom of the filler hole when the simulator is resting on a bench in operating position.

(3) REASSEMBLY.—Store the simulators until a point in the reassembly of the trainer is reached when they can be installed and connected. (Refer to Section IV, paragraph 5*e*(24).)

e. BELLOWS.

(1) CLEANING, INSPECTION, TESTING, AND REPAIR.

(*a*) GENERAL.—All bellows in the trainer, except the turning motor bellows, should be refabricated or replaced during a complete overhaul. This is particularly true of the air-speed and manifold pressure indicator regulator bellows which will cause false instrument indications unless they are in perfect condition. The only exception to this recommended replacement or recoverage is where the bellows have been so treated within a comparatively short time previous to the complete trainer overhaul.

(*b*) INSPECTION.—Inspect the bellows for leakage; plug all openings tightly with the bellows in a collapsed condition. Grasp the bellows plates firmly and attempt to expand the bellows. The inherent slight porosity of the bellows fabric

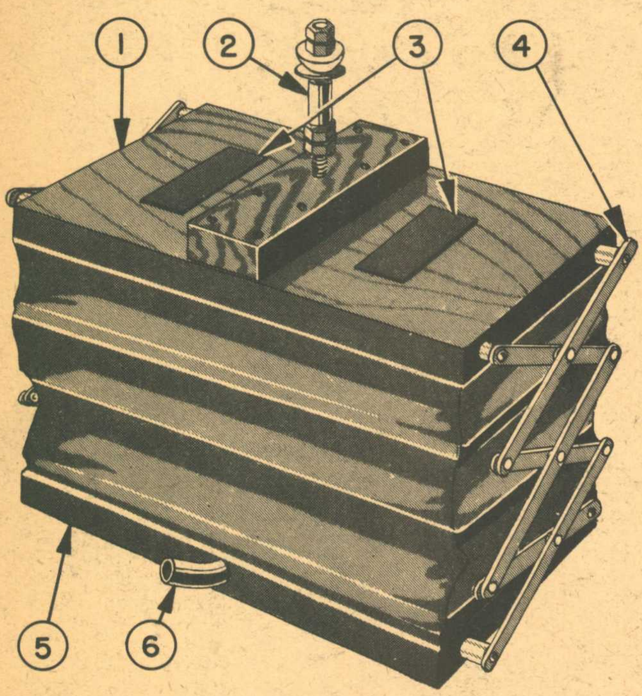


Figure 91—Main Bellows

1. *Top Section*
2. *Bellows Stud*
3. *Flap Valve*
4. *Toggles*
5. *Bottom Section*
6. *Elbow*

will permit a slow expansion; but if, upon release of the pull, the bellows plates tend to spring together, no leak is indicated. If the bellows expands readily with no inclination to collapse when released, a leaky condition is indicated. See that the fabric is firmly cemented at the edges and that the hinge at the end is firm and not cracked (this applies to the small type of bellows). See that the elbows are firmly cemented to the plates.

(*c*) INSTRUCTIONS FOR PATCHING BELLOWS.

1. Stix Rapid Adhesive, manufactured by Cardinell Corporation, Montclair, New Jersey, is recommended for patching the bellows. Most other cements dry too hard, become brittle, and crack or loosen in a short time.

2. To avoid undue stiffness, the patch should be of a material a grade lighter than the fabric being patched.

3. Both surfaces must be clean and dry. Each surface should be given a generous coating of cement, well rubbed in, and a second coat applied at once. Press the two surfaces together firmly, rub down or put under pressure, and leave for an hour before applying vacuum.

4. Two escape valves, each consisting of a row of holes through the top plate, covered by a strip of bellows fabric, tacked down smoothly with three tacks at each end, are provided on the top of each main bellows. This strip must lie flat (edges not curled) to avoid leakage. If the strip does not fit properly, it should be replaced by similarly tacking on a new piece of fabric.

(2) REFABRICATION OF BELLOWS.

Note

As the process of refabricating all bellows used in the trainer is the same, detailed instructions are given only for the main pitching and banking bellows, which represent one type used, and the turn indicator bellows, which represents the other type of bellows used.

(*a*) MAIN BELLOWS.

1. Remove toggle assemblies from the ends of the bellows.

2. Remove the old fabric from the bellows frame assembly and clean the wooden surface thoroughly, removing all of the old glue adhering

to the wooden surface. This can be done easily with sandpaper by hand or with an electric sander. Use care not to remove any of the wood when sanding off the glue.

3. Cut the new fabric in accordance with the fabric dimensions given in figure 93.

4. Mark the cut fabric on the white side according to instructions in figure 93.

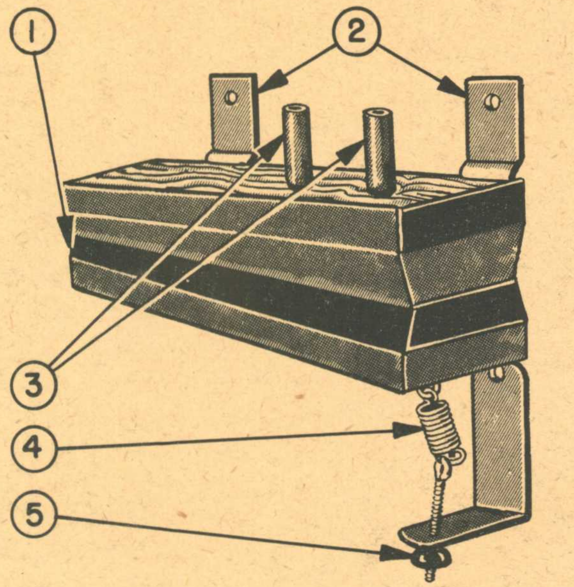


Figure 92—Turn Indicator Bellows

1. *Hinge*
2. *Brackets*
3. *Tubing Vacuum Connections*
4. *Coil Spring*
5. *Adjusting Ball Nut*

5. Lay the fabric, white side up, lengthwise on the bench with the pencil mark to the left.

CAUTION

Use hot animal glue for covering operations where the fabric is attached to wood.

6. Apply a coat of glue to the edge surface of the top wooden section of the bellows.

7. Place the top wooden section of the bellows in position, bellows hook-up stud away from the operator with the left corner of the wood on the pencil line, and the top edge even with the edge of the fabric.

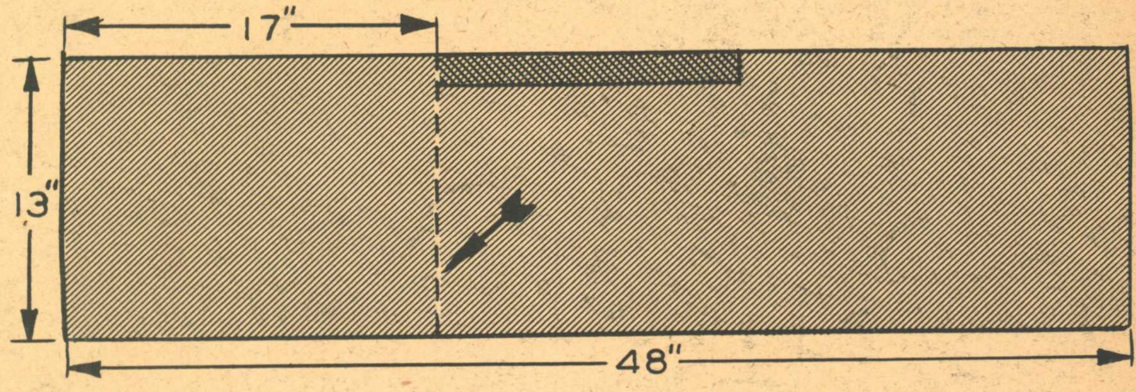
8. Tip the section forward and backward to work the glue into the fabric and remove the section.

9. Apply a second coat of glue to the edge of the wood and replace in position, pressing it tight against the fabric. Allow time enough for the glue to set. A block of wood may be placed under the bellows hook-up stud to hold it upright while the glue sets. (See figure 96.)

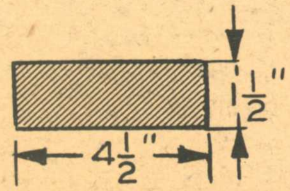
10. Apply glue to the air hole side of the bottom section of the bellows and place it against the fabric even with the pencil line and the edge of the fabric.

Note

The air hole must be on the bottom.



Fabric Pattern (above) for Main Pitching and Banking Bellows



Fabric Pattern (left) for Flap Valves on Main Pitching and Banking Bellows

Figure 93—Fabric Patterns for Main Bellows

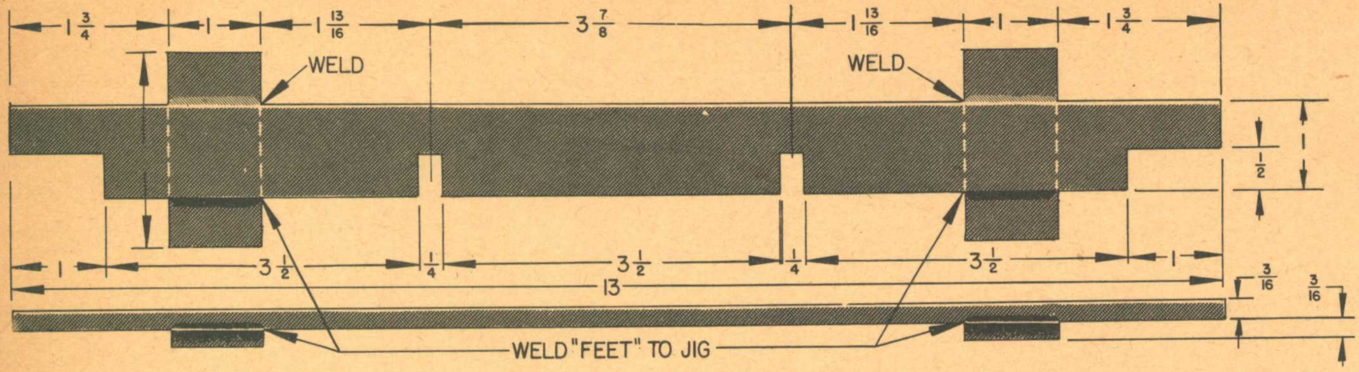


Figure 94—Spacing Jig

11. Work the bottom section backward and forward to press the glue into the fabric. Then remove it and apply a second coat of glue. Place the bottom section in position on the fabric and press it firmly. Tighten the fabric until the glue has set.

12. Place the metal jigs in position as illustrated in figure 96.

Note

Two jigs are required. These jigs may be easily made by following the dimensions given in figure 94. The jigs should be made of material heavy enough so that they will contribute to the work of holding the bellows fabric steady.

13. Apply glue to one edge of the upper spacer and position it in the jig. (See figure 96.) Work the glue into the fabric, remove the spacer, apply a second coat of glue, replace the spacer in the jig and press firmly against the fabric. The spacer may be held in a vertical position by a block or a brick, as shown in figure 96, while the glue is drying.

14. Apply a coat of glue to one edge of the lower spacer and place it in position in the jig, repeating the same procedure as given in paragraph 13, above.

15. Place the two special clip-clamps into position on the top of the bellows structure. (See figure 97.)

Note

Two clip-clamps are required. These clip-clamps are easily made by following the instruction given in figure 95.

16. Remove the metal jigs. Wrap the loose ends of the fabric around the bellows and turn the entire assembly upside down so that it rests on the two clip-clamps.

17. Iron the fabric smoothly to the wood at the four places where glue has been applied.

Note

Ironing the fabric may be accomplished with any smooth steel tool handle or hammerhead. A tool with a slightly curved surface makes better contact at all points.

18. Tack the fabric to the wood frame with 3/8-inch, No. 20 wire nails, Specification No. AN-301-20-3, at approximately 1/4-inch from the corner of the frame, to hold the fabric taut.

19. Tack two sticks to the bellows frame, flush with the corner, to hold the form of the bellows and to keep the fabric taut. (See figure 98.)

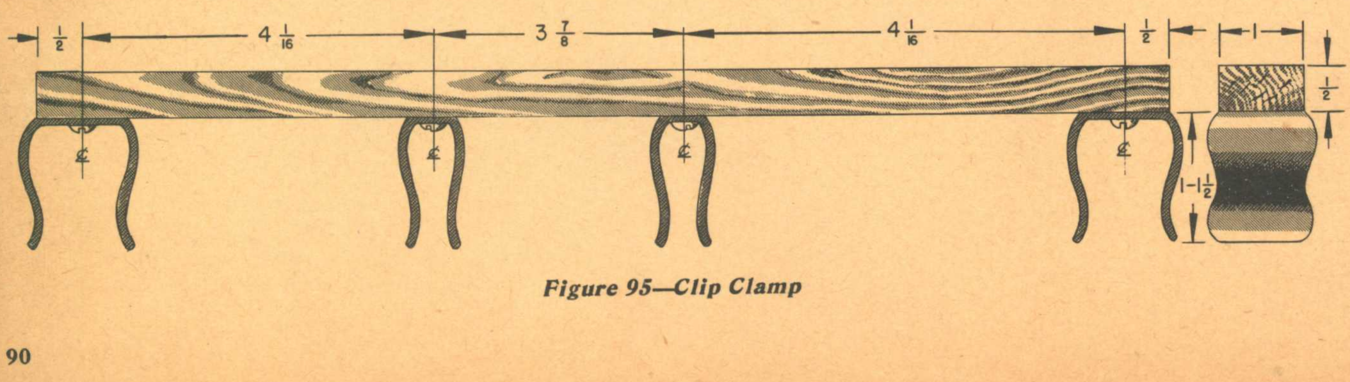


Figure 95—Clip Clamp

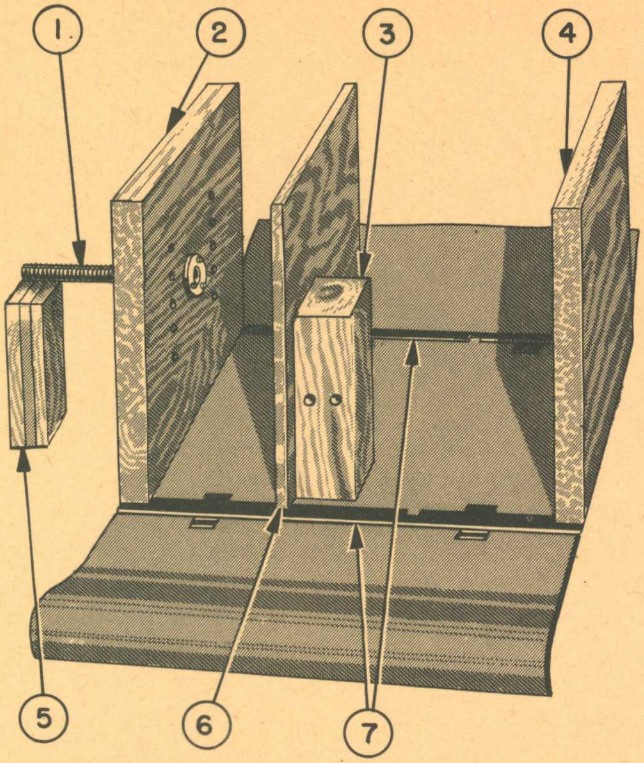


Figure 96—Refabricating Main Pitching and Banking Bellows—First Operation

1. *Bellows Connecting Stud*
2. *Bellows Frame, Top*
3. *Block to Support Top Spacer*
4. *Bellows Frame, Bottom*
5. *Block to Support Stud*
6. *Top Wood Spacer*
7. *Spacing Jigs*

20. Turn the assembly up on one end, as shown in figure 98, and apply glue to the edges of the top and bottom sections and to the two spacers.

21. Stretch the fabric taut and iron it into position on the frame. Peel the fabric back and apply a second coat of glue to the wood frame.

22. Reposition the fabric against the frame and iron the fabric firmly in place. Pay particular attention to the corners where pockets can form if each succeeding stretch of fabric is not firmly glued.

23. Tack the four corners of the fabric as in paragraph 19 above, but do not tack the fabric to the spacers. Tack on two sticks to hold the form of the bellows as in paragraph 19 above. Remove the clip-clamp and lay the bellows on its side.

24. Stretch the fabric into position on the front side and mark the edge of one end on the spacers where the fabric stops.

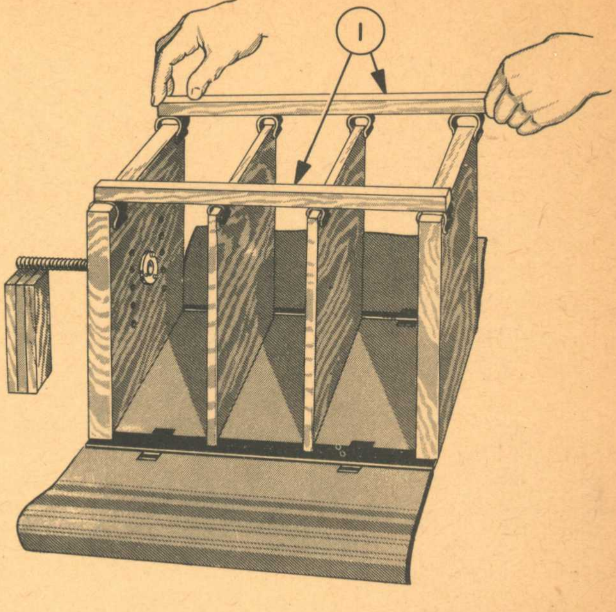


Figure 97—Refabricating Main Pitching and Banking Bellows—Second Operation

1. *Clip Clamps*

25. Fold the fabric back to the corners and apply glue to the wood surface from the corner to the pencil marks.

26. Stretch the fabric into position against the glued surface. Iron the surface to work the glue into the fabric, then peel the fabric back to the corner.

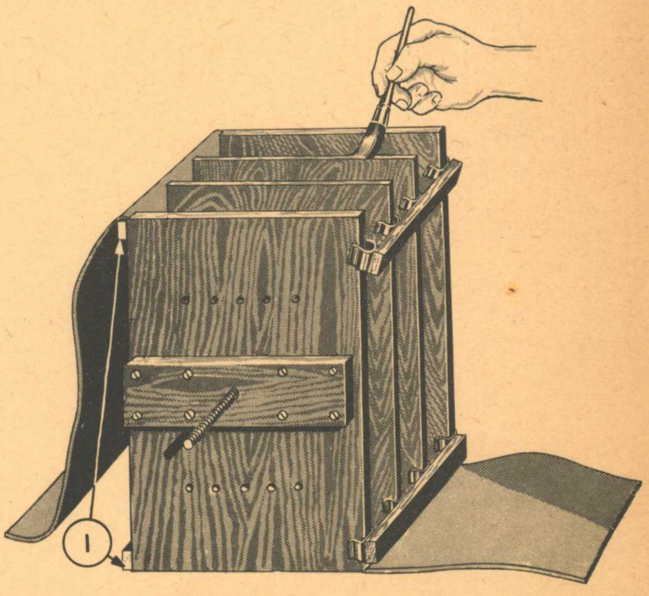


Figure 98—Refabricating Main Pitching and Banking Bellows—Final Operation

1. *Tightening Sticks*

27. Apply a second coat of glue to the wood and again apply the fabric, ironing it taut against the glued surface. Tack the ends of the fabric in position. Place the tacks 3/16 to 1/4 inch from the edge of the fabric.

28. Apply a coat of glue to the remaining exposed edges of the frame and spacers. Stretch the last fold of fabric into position. Iron the fabric to work the glue into the fabric and peel it back to the corner. Apply a second coat of glue to the wood frame and stretch the fabric taut into position. Iron the fabric firmly against the wooden frame.

29. At the point where the top layer of fabric overlaps the end of the lower layer, place four tacks in the overlapping fabric, close to the end of the lower layer, but not through the lower layer.

30. Mark with a pencil where the top layer of fabric comes on the lower layer. Apply a coat of (Stix) rubber cement to the lower fabric surface of the overlap up to the pencil line, and place the overlapping fabric firmly in position.

31. Peel back the overlapping fabric and apply a coat of (Stix) rubber cement to the under (white) surface of the flap. Reposition against the lower surface and smooth the fabric with an iron.

32. Tack the edge of the overlapping seam just made and wipe off the excess cement.

CAUTION

Before proceeding, inspect the corners for loose fabric peeling, and iron tight any loose corners. Go back over the overlapping section and work the rubber cement in thoroughly with an iron.

33. Paint the exposed wood surfaces at the top and bottom of the bellows and lay the assembly aside to dry.

34. Cut the two bellows release flaps from the fabric and tack them into position on the top of the bellows.

Note

For proper functioning, it is essential that this fabric strip lies perfectly flat against the top surface of the bellows.

35. Remove the sticks which were tacked to the bellows frame to hold it firm during the fabrication procedure.

36. Install the toggle assemblies and air connection elbow, cutting the fabric away over the air hole to insert the elbow. Seal the elbow in place with shellac.

37. Secure the bellows in a collapsed condition with a strip of metal. (See figure 99.)

(*b*) TURN INDICATOR BELLOWS.

1. Cut a strip of fabric 15-1/4 x 2 inches and mark a pencil line across the fabric 8-1/2 inches from one end. (See figure 100.)

2. Spread a coat of glue on the edges of one side and on the open end of a bellows frame and place it on the fabric, hinged end up, and spread open to the width of the fabric, as shown in figure 101.

3. With the end properly placed against the marker line, press the glued side against the fabric in the position shown in figure 101. Work the glue into the fabric. Peel the fabric off, coat the frame with a second coat of glue, and iron the fabric to the bellows frame.

4. Proceed around the frame, as shown in figures 102 and 103, until the fabric is completely glued to the frame.

Note

Notching the fabric at each corner as it is turned, will aid in stretching the fabric smoother and tighter.

5. Tack the fabric overlaps with four tacks, trim off any excess fabric, paint the exposed wood, and seal in the tubing joints with shellac.

Note

The stall valve, air-speed, tachometer, spin, and spin-trip bellows are all of the same type as the turn indicator bellows and the procedure followed in refabrication is the same. Fabric patterns are shown in figure 100.

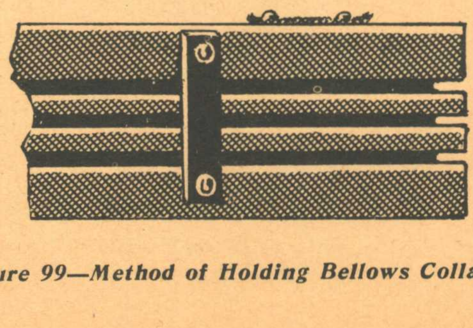
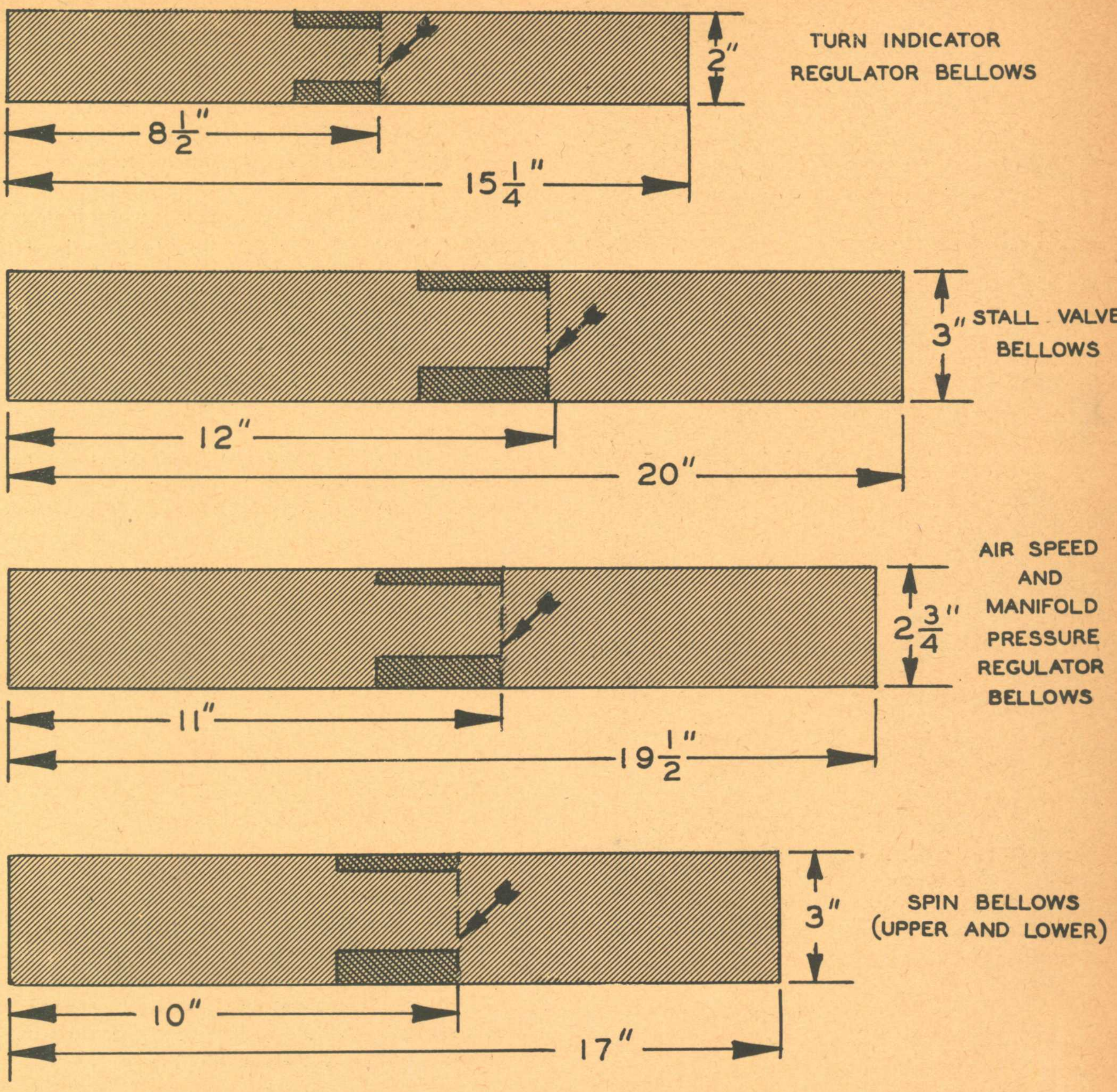
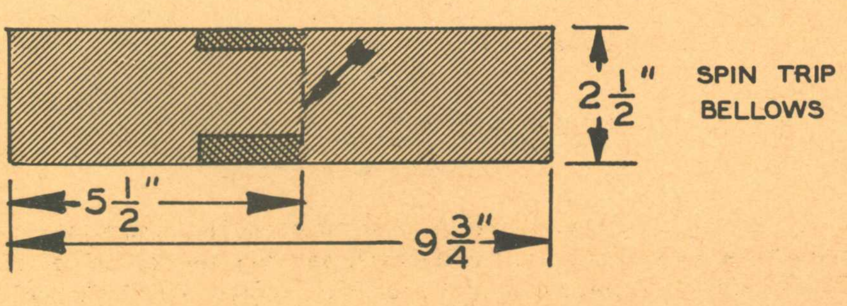


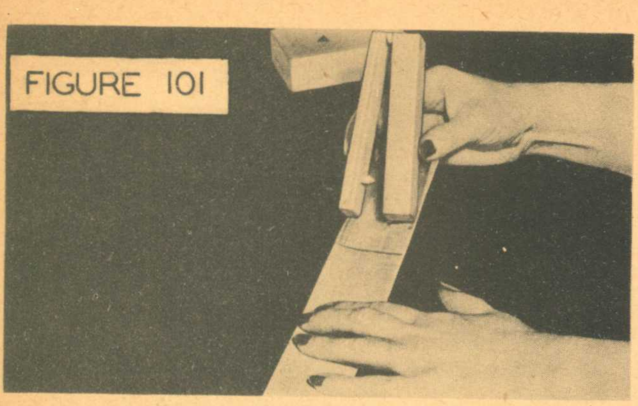
Figure 99—Method of Holding Bellows Collapsed

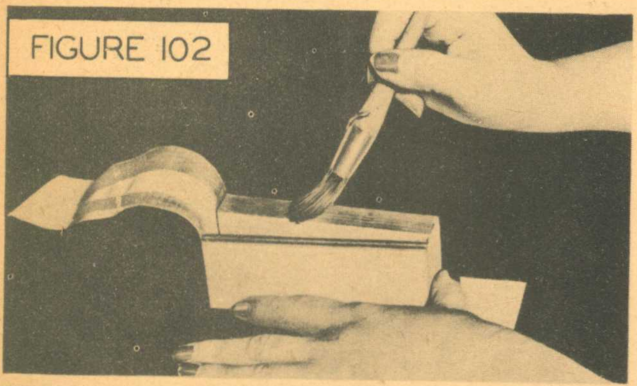


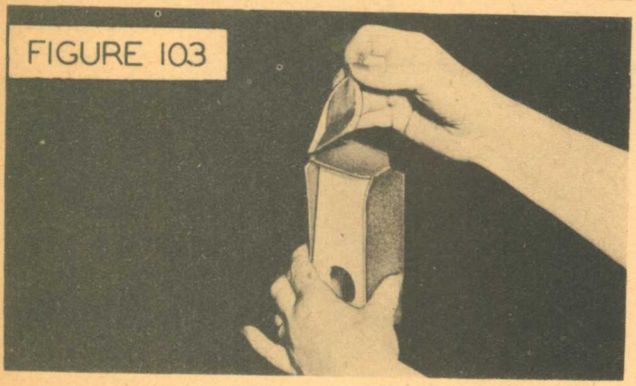


Vertical broken lines across each pattern is reference mark for first gluing operation. Marks assure proper fabric overlap. Overlap must always come at hinge end of bellows. Dark shaded areas indicate placement of frame for first gluing operation.

Figure 100—Fabric Patterns for Small Bellows







Refabricating Small Bellows

Figure 101—First Operation

Figure 102—Second Operation

Figure 103—Final Operation

f. FUSELAGE CONTROL BOX. (*See figure* 64.)

(1) Inspect all wiring and cable assemblies for evidence of wear or damage. See that all soldered connections are clean and unbroken and that all screw terminals are tight.

(2) Wires that have been placed outside their cable assemblies to effect temporary repairs should be properly tied into their assemblies.

(3) Inspect all insulation for evidence of wear or breakage and install new wiring whenever there is visual evidence of deterioration.

g. TRANSMITTER PANEL JUNCTION BOX. (*See wiring diagram, figure* 65.)

(1) Inspect all wiring and cable assemblies for evidence of wear or damage. See that all soldered connections are clean and unbroken and that all screw terminals are tight.

(2) Wires that have been placed outside their cable assemblies to effect temporary repairs should be properly tied into their assemblies.

(3) Inspect all insulation for evidence of wear or breakage and install new wiring whenever there is visual evidence of deterioration.

Note

Effective with instrument flying trainer, AN-2550-1, Link Serial No. 7500, the transmitter panel junction box was replaced by a terminal strip on the left side of the transmitter panel.

h. INTERCONNECTOR BOX. (*See figure* 72 *and wiring diagram, figure* 63.)

(1) Inspect all wiring and cable assemblies for evidence of wear or damage. See that all soldered connections are clean and unbroken and that all screw terminals are tight.

(2) Wires that have been placed outside their cable assemblies to effect temporary repairs should be properly tied into their assemblies.

(3) Inspect all insulation for evidence of wear or breakage and install new wiring whenever there is visual evidence of deterioration.

i. BASE TERMINAL BOX. (*See figure* 4 *and wiring diagram, figure* 123.)

(1) Inspect all wiring and cable assemblies for evidence of wear or damage. See that all soldered connections are clean and unbroken and that all screw terminals are tight.

(2) Wires that have been placed outside their cable assemblies to effect temporary repairs should be properly tied into their assemblies.

(3) Inspect all insulation for evidence of wear or breakage and install new wiring whenever there is visual evidence of deterioration.

(4) Clean the silver contacts of the line starter with fine sandpaper. Replace, if badly pitted.

(5) Inspect all transformers for corrosion and for poor insulation. Transformers that are badly corroded or show evidence of poor insulation should be replaced.

(6) See that the Jones plug connections and fuses are free of corrosion and that they make good contact.

(7) Connect 110-volt ac to terminals (2) and (3) of the terminal strip located between the 32-volt transformer and the 33-pole receptacle connection.

(8) Check the output voltage of the 32-volt transformer and the 12-volt brake supply transformer.

(9) Turn the turbine switch on and check the line starter. If the starter chatters or arcs, check the alignment of the solenoid and the tension of the spring under the contacts.

j. DESK JUNCTION BOX. (*See figures* 66 *and* 67.)

(1) Inspect all wiring and cable assemblies for evidence of wear or damage. See that all soldered connections are clean and unbroken and that all screw terminals are tight.

(2) Wires that have been placed outside their cable assemblies to effect temporary repairs should be properly tied into their assemblies.

(3) Inspect all insulation for evidence of wear or breakage and install new wiring whenever there is visual evidence of deterioration.

k. VIBRATOR MOTORS. (*See figure* 104.)

(1) Clean the motors thoroughly.

(2) Remove the flywheels from the shaft and inspect the felt lubricating ring. If the lubricating ring is gummy or stiff, replace it with a new ring,

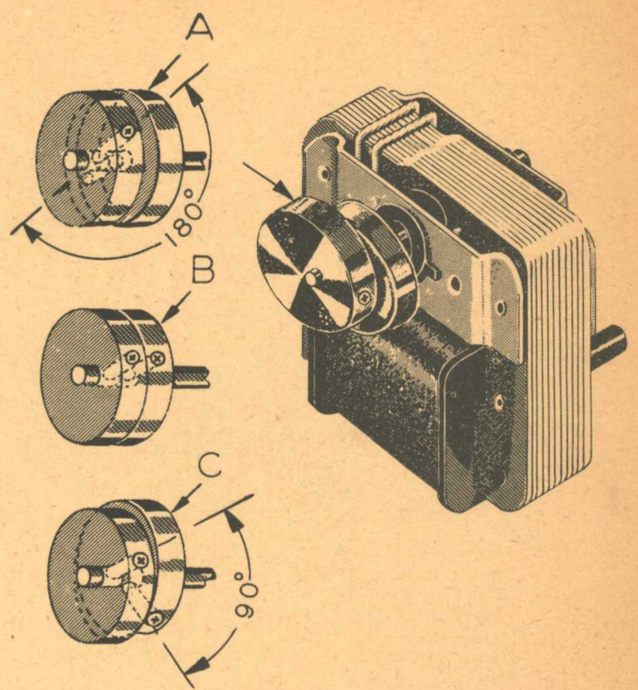


Figure 104—Vibrator Motor

saturating the new ring with light oil, Specification No. AN-0-6.

(3) Inspect the motor for proper end play of the shaft. End play should not be more than .003 of an inch. To reduce end play loosen the setscrew in the flywheel nearest the motor and, holding the outer flywheel firmly, move the inner flywheel toward the motor and tighten the setscrew. There should be sufficient end play so that the motor may be turned freely by hand.

l. TURNING MOTOR. (*See figure* 105.)

(1) DISASSEMBLY.

(*a*) Scribe a mark across the faces of the two small gears (3, figure 105) on the ends of the crankshafts and the large gear with which they mesh. This will insure reassembly of the gears in their original positions.

Note

Complete the inspection and overhaul procedure on one bank of the turning motor before starting work on the other bank, so that all parts may be reassembled to their original bank.

(*b*) With the motor standing on a bench, with the two crankshafts at the top, remove the crankshaft bearing housings.

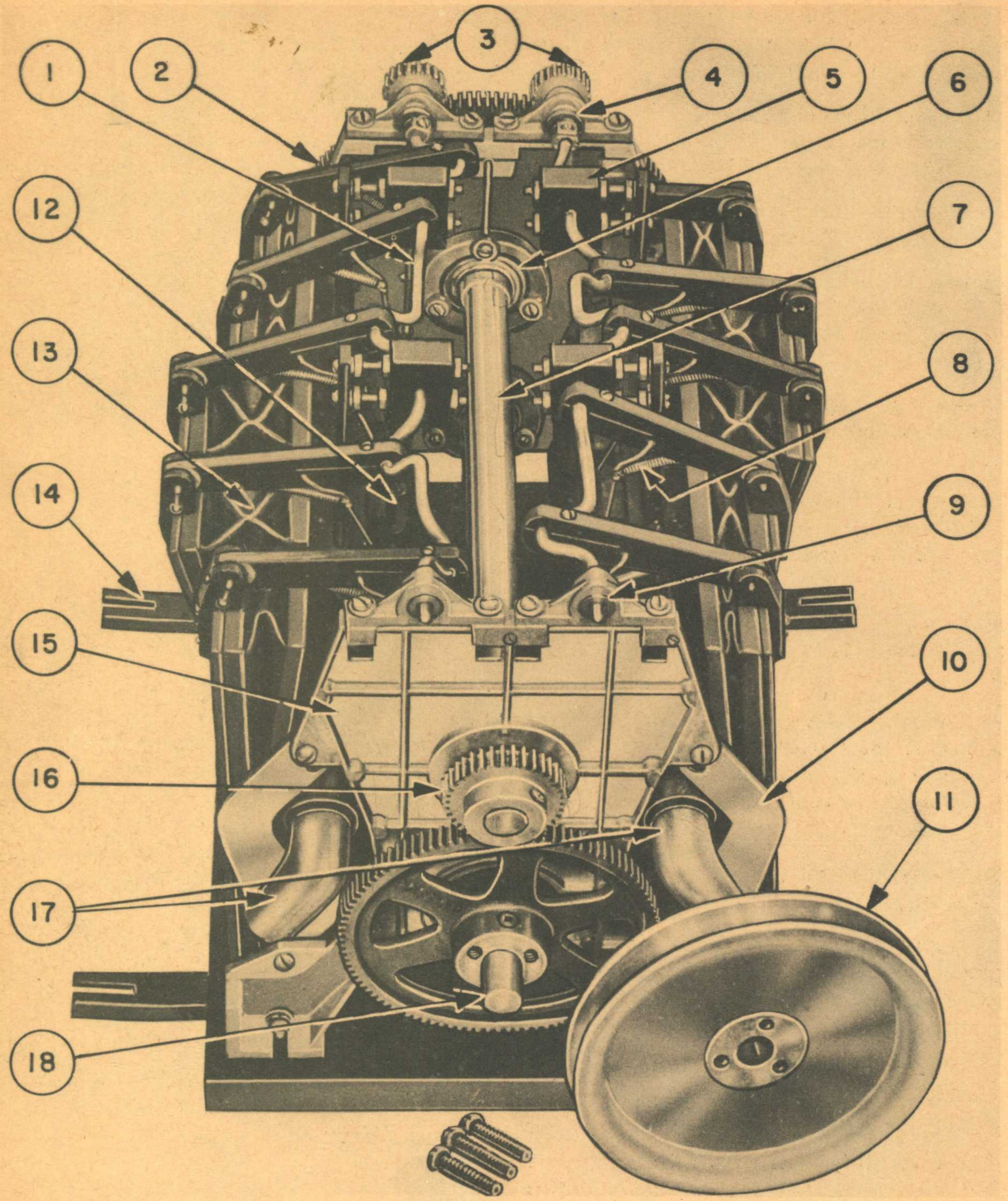


Figure 105—Turning Motor

1. *Crankshaft*
2. *Connecting Rod (10)*
3. *Crankshaft Drive Gear*
4. *Crankshaft Bearing Collar*
5. *Intermediate Bearing*
6. *Drive Shaft Bearing (4)*
7. *Front Drive Shaft*
8. *Valve Slide Tension Spring (10)*
9. *Crankshaft Bearing Housing*
10. *Bank Mounting Plate*
11. *Turning Motor Pulley*
12. *Valve (10)*
13. *Bellows (10)*
14. *Hanger Support*
15. *End Plate*
16. *Front Shaft Top Gear*
17. *Elbow (Vacuum Supply)*
18. *Rear Drive Shaft*

(*c*) Remove the screws from the top of the two bank mounting plates (10, figure 105), one on each end of the bank.

Note

The screws behind the large gear on the end of the bank where the vacuum supply elbow is located can be reached through a hole near the edge of the large gear.

(*d*) Loosen (do not remove) the screws at the bottom of each bank mounting plate.

(*e*) Tip the top of the bellows bank outward from the motor and let it lie flat on the bench as in figure 106.

(*f*) Test the five small double bellows comprising this bank by plugging the vacuum supply elbow (17) with the thumb and then grasping the small gear (3) at the end of the crankshaft and turning in the direction that causes resistance of the bellows. If the resistance is constant during the course of expansion and contraction of each of the small bellows until all have been operated, there

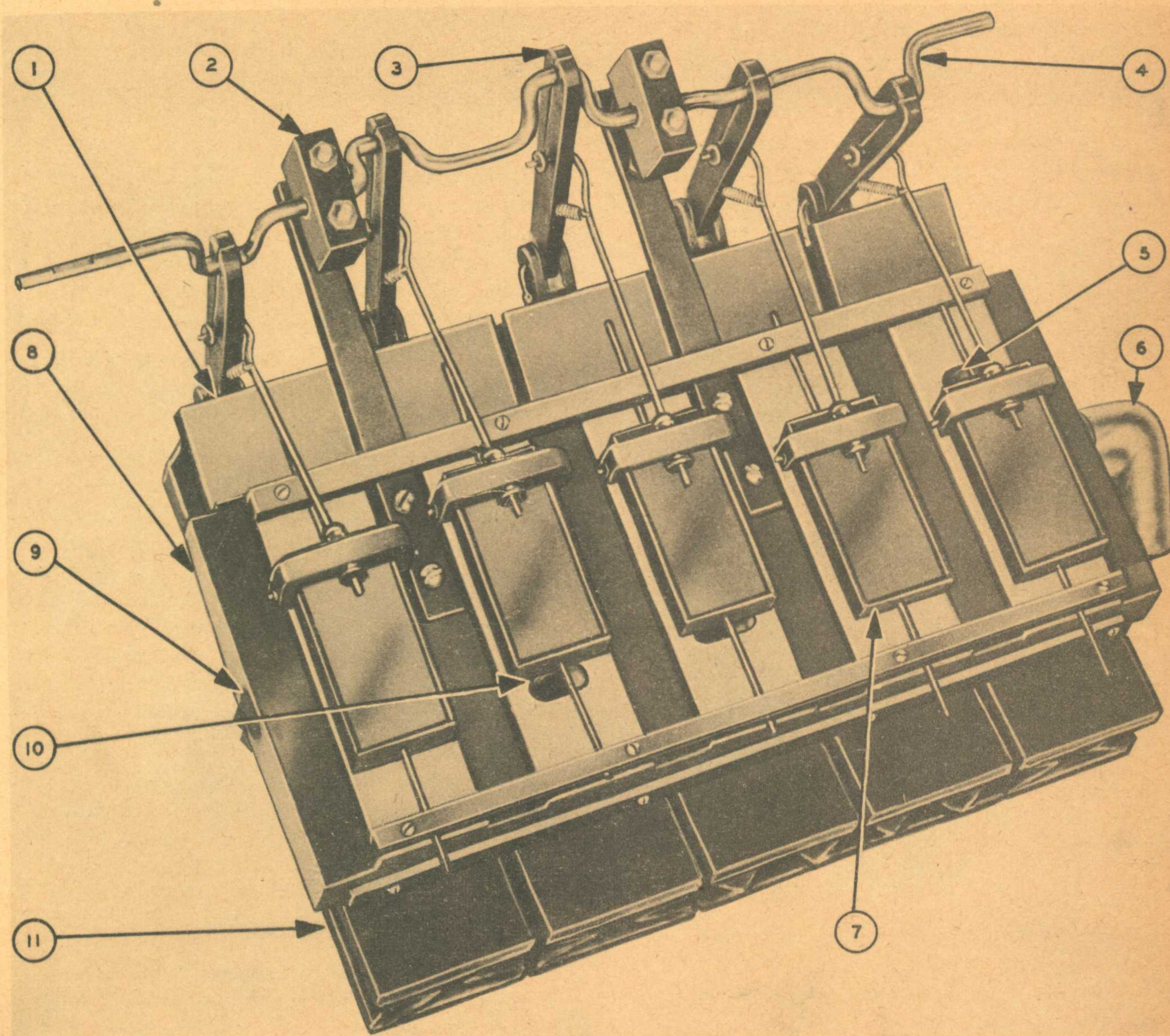


Figure 106—Turning Motor (Left Bank)

1. Bellows
2. Intermediate Bearing
3. Connecting Rod
4. Crankshaft
5. Port
6. Vacuum Supply Elbow
7. Sliding By-Pass Valves
8. Base
9. Vacuum Duct
10. Port
11. Bellows

are no leaks in the bellows. If there is a lack of resistance at any point, note which bellows is being expanded at the moment so that a search may be made for either a leak in the bellows or an imperfectly fitting valve.

(*g*) If a point of weak resistance has been found in the operation of the bank it will be necessary to inspect the operation of the individual bellows and the sliding valves and valve seats. Proceed as follows: (See figure 107.)

1. Remove the leather or fiber nuts (2).

2. Unhook one end of tension springs (3).

3. Remove the push rods (5) from the connecting rods (4).

4. Move the sliding valve (9) far enough to release the wire guide on first one end, and then the other, and remove the sliding valve.

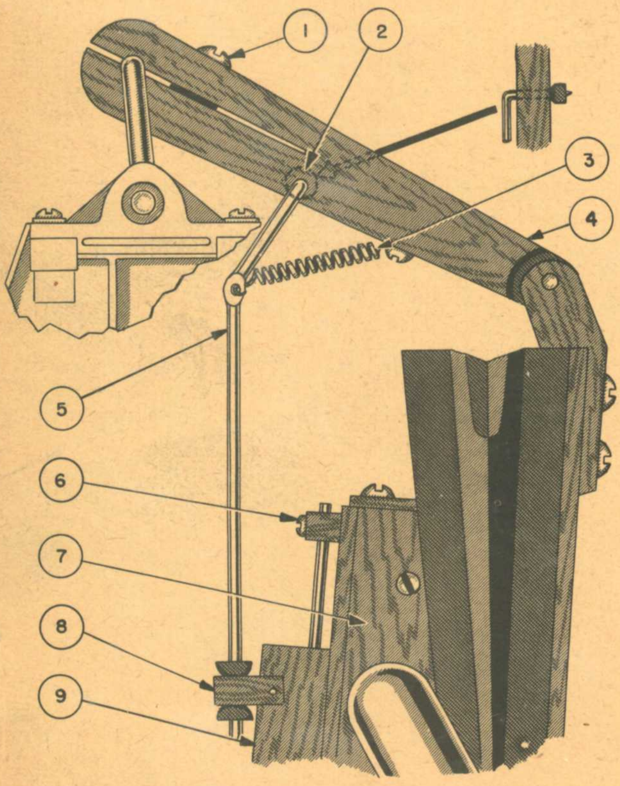


Figure 107—Turning Motor Valve Detail

1. *Crankshaft Bearing Screw*
2. *Leather Nut (Behind Connecting Rod)*
3. *Tension Spring*
4. *Connecting Rod*
5. *Push Rod*
6. *Valve Guide*
7. *Valve Seat*
8. *Valve Guide Block*
9. *Sliding Valve*

5. Grasp the crankshaft below the bellows believed to be defective and, with the thumb over the outside port (5) or (10), turn the crankshaft to open the bellows. Test the resistance to expansion of both of the bellows venting in this section of the valve face.

(*h*) If a leak is discovered in the bellows, it should be patched in accordance with the instructions contained in Section IV, paragraph 3*e*(1) (*c*). If the patch to be applied covers a fold of the bellows, the patch should be creased to fit the fold in the bellows, either before or after it is applied. A pair of pliers may be used for this purpose. If the bellows cannot be patched satisfactorily, a complete new bank must be installed on the turning motor.

(*i*) Inspect the valve seat and the sliding valve. Sand out any irregularity in the sliding valve by using a sheet of No. 400 sandpaper on a steel bench plate. A small block of wood faced with sandpaper should be used on the valve seat if it is of wood construction. Inspect the valve guide wires at each end of the slide valve. A slightly bent condition might cause an imperfect contact with the seat.

(*j*) Inspect the fabric covering on the top of the sliding valve to determine that it is firmly cemented to the wood.

(*k*) Disassemble the crankshaft and the connecting rods as a unit by removing the small gears from the ends of the connecting rods (figure 105). Loosen the spacing collar and remove the connecting rod pins. Remove the crankshaft bearing nuts and take off the freed half of the bearing. The crankshaft may then be dismounted by sliding it toward the drive gear end until the pulley end of the crankshaft is free and then drawing back to free the drive gear end. Do not remove the small gears (3, figure 105).

(*l*) Loosen the screws at the top of the hardwood connecting rods and slide the rods carefully off the crankshaft, turning them at each bend so the rod points away from the outer axis of the bend.

CAUTION

Mark or tag each part so that it may be reassembled to the same subassembly from which it was removed.

(*m*) Remove the entire bank by removing the bottom screws in the bank mounting plate (10, figure 105).

(2) LUBRICATION OF VALVES.

(*a*) Unscrew the leather or composition nuts where the valve rods hook to the connecting rods, unhooking the coil springs and removing the valves.

(*b*) Prepare a graphite paste by mixing turpentine and varnish, 30 parts of turpentine and one part of varnish, and thickening with powdered graphite, U. S. Army Specification No. 2-64, until the mixture is quite stiff.

(*c*) Dip a dry cloth into the paste, rub on the valve face, and let stand for about a minute. Then, with another dry cloth add dry graphite and polish.

(*d*) Polish the wooden valve face plates in the same manner as the sliding valves.

Note

All instrument flying trainers, effective with Link Serial No. 5551, are equipped with metal valve face plates. The metal face plates require no graphite or other lubrication.

(*e*) The turning motor gears should be greased lightly with medium grease, Specification No. VV-G-681. The ball bearings are of the sealed type and require no lubrication.

CAUTION

Do not permit oil to get on either the faces of the valves or on the bellows. Use oil sparingly on the turning motor.

(3) CRANKSHAFT—ALIGNMENT.

(*a*) Crankshaft alignment must be carefully checked to determine that the five separate crank throws are exactly 72 degrees apart.

(*b*) If the crankshaft is out of alignment, a new one should be installed.

(4) REPLACEMENTS.—Link rods, leather or composition nuts, tension springs, gears, and bearings should be replaced if they are in a worn or damaged condition.

(5) REASSEMBLY.

(*a*) Thread the connecting rods back onto the crankshaft, replace the spacing collar, and reinsert the crankshaft into the motor frame.

(*b*) Secure the crankshaft bearing blocks in position. Tightness in these bearings will cause binding on the crankshaft which must be eliminated by adjustment of the bearing blocks.

(*c*) Secure the connecting rods to the bellows with the pivot pins.

(*d*) Link the sliding valves to the connecting rods by a link rod, leather nuts, and a tension spring. (See figure 107.)

(*e*) By shifting the crankshaft, find the position where the connecting rods lie approximately centered on their respective crank throws and lock the crankshaft in that position by tightening the spacing collar. Attach the small gears to the crankshafts. Do not tighten permanently.

Note

Since the turning motor is mounted gear end down, the one spacing collar on the gear end of the crankshaft should maintain the position found in paragraph (*e*), above.

(6) SCRATCH, OR FINAL TUNING.

(*a*) After a turning motor has been left standing, or packed, in one position for a considerable time, it is noticeable that when turning the motor over by hand, the banks have a very definite throw in some certain position. This set in the banks must be remedied before tuning the turning motor for final testing.

(*b*) Having marked the two small gears and the large gear into which they mesh, so they may be returned to their original positions, loosen the setscrew in the hub and pull out the small gear and turn it to 180 degrees from the other small gear, and tighten the setscrew. This procedure should eliminate a large part of the motor throw.

(*c*) Finer adjustment can then be made by moving the small gear one or two teeth to the right or left and, by trial and error method, until smooth operation of the motor is obtained.

(*d*) After the motor has been installed on the trainer, or on a test stand, if a rapid oscillation occurs on the turn indicator, this can be reduced by changing the gear timing on the turning motor just one tooth, one way or the other.

(7) PRE-INSTALLATION TEST. — After the turning motor has been assembled, inspect the following points before installing it on the trainer:

(*a*) Both hose properly connected.

(*b*) No leaks in the bellows.

(*c*) No loose or missing patches.

(*d*) Slide valve springs all in place.

(*e*) No leather or composition nuts missing.

(*f*) Valves all in place and working properly.

(*g*) Valve seats well graphited (no bare wood showing).

(*h*) Connecting rods not binding.

(*i*) Crankshaft pinion gears tight on the shaft.

CAUTION

Make sure there is absolutely no bind in the connecting rods, as even a slight amount will cause uneven running of the motor. It is better to have the rods too loose than too tight. If squeaking occurs at the bearing of these rods, apply powdered graphite.

m. WIND DRIFT MECHANISM. (*See figure* 108.)

(1) DISASSEMBLY.

Note

Due to the many sensitive mechanisms and the critical adjustments involved, repair or complete overhaul of the wind drift mechanism should be accomplished only by personnel especially trained for this work. If trained personnel is not available, the unit should be removed from the trainer and returned to the manufacturer for overhaul rather than risk damage to the equipment by inexperienced personnel.

(*a*) Remove the covers.

(*b*) Remove the arm assembly drive rocker as follows:

1. Remove the coil spring.

2. Remove the rocker arm bracket assembly by taking out two screws.

3. Remove the coupling assembly drive.

(*c*) Remove the drive assembly directional control (relative wind angle differential) by taking out four screws holding the assembly to the base and two screws in the wind direction control bracket.

(*d*) Turn the entire mechanism over and remove the base plate by taking out six screws.

Note

Beginning with Link Serial No. 6370, this design was changed so that the base is now attached with four screws.

(*e*) Remove the cable and receptacle as follows:

1. Unsolder all electrical connections of cable terminals.

2. Remove four screws from the main receptacle and uncouple the receptacle.

3. Remove five screws from the wiring in the teletorque case.

4. Remove two clips holding the cable and remove the cable.

(*f*) Remove the anti-backlash motor.

(*g*) Remove the ground-speed motor (7, figure 50).

(*h*) Remove the air-speed follow-up motor assembly, as follows:

1. Loosen the nut inside the case that holds the supporting rod and remove the nut and washer on the rod outside of the case. Remove the air-speed rack by removing two screws.

2. Remove the follow-up motor control cable. This must be done carefully by pulling the cable out until the knot in the cable is on top of the pulley where it can be reached. Hold the drum from revolving and untie the knot. Allow the drum to slowly unwind until the spring tension is zero. Care must be taken not to allow this drum to unwind too rapidly or the spring will fly out and the contact point may be damaged.

3. Remove three mounting screws and pull out the motor.

(*i*) Remove the right-angle drive as follows:

1. Loosen the two setscrews in the collar on the main shaft.

2. Remove the nut holding the right-angle drive to the end plate and take off the drive.

(*j*) Remove the track teletorque assembly by taking four screws out of the housing.

(*k*) Remove the ground-speed drive contact assembly by taking out its two mounting screws.

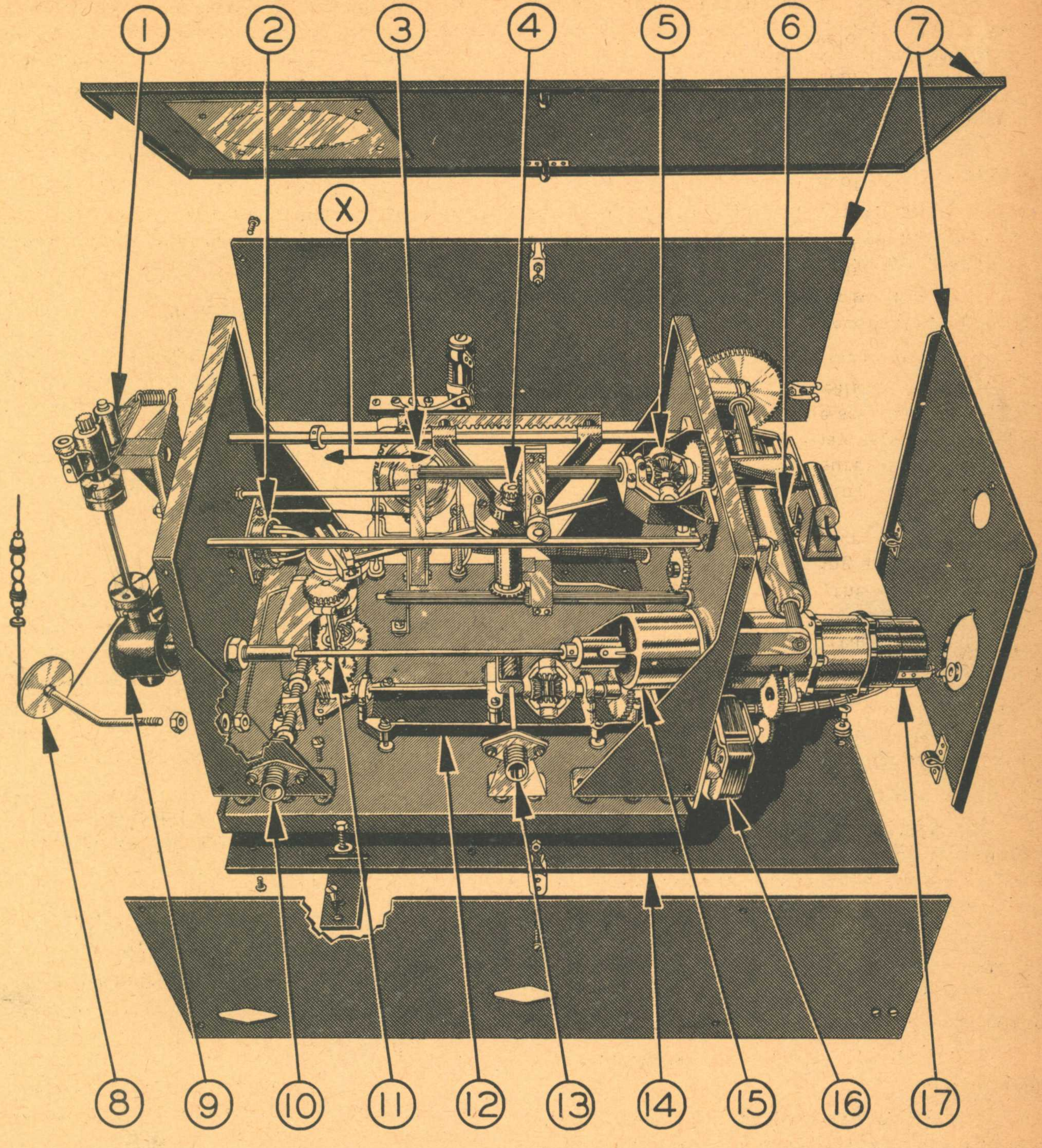


Figure 108—Wind Drift Mechanism

1. Arm Assembly—Heading Drive Rocker
2. Cable Assembly and Receptacle
3. Electric Throttle Control Arm
4. Air-Speed Carriage Assembly
5. Ground-Speed Differential Assembly
6. Ground-Speed Drive
7. Cover Assembly
8. Air-Speed Cable Pulley
9. Right Angle Drive
10. Wind Velocity Control
11. Wind Triangle Assembly
12. Drive Assembly, Directional Control
13. Wind Direction Control
14. Base Plate
15. Autosyn Housing Assembly
16. Anti-Backlash Motor
17. Track Teletorque

(*l*) Remove the bearing cap from the ground-speed drive assembly and remove the assembly which includes the ground-speed rack, cam, gear, and shaft.

(*m*) Remove the two air-speed cable pulleys.

(*n*) Remove the lower spline shaft assembly, as follows:

1. Rotate the gear on the outside of the case until the screws are visible through the hole in the gear. Remove the screws through this hole.

2. Pull out the lower splined shaft assembly with the gear.

(*o*) Loosen the setscrew in the collar on the wind-speed drive and run the wind-speed rack out of the wind bar by turning the wind-speed drive counterclockwise.

(*p*) Remove the air-speed carriage as follows:

1. Remove the track carriage support.

2. Loosen the setscrew in the stop collar on the upper rod.

3. Remove the two screws in the bar and stud assembly on the outside of the case behind the ground-speed assembly (which has previously been removed).

4. Drop the bar from which the two screws were removed and the track may be pulled out.

5. Lift out the air-speed carriage.

(*q*) Remove the ground-speed differential (wind-drift subtraction differential) by removing the four screws which attach the assembly to the inside of the end frame.

(*r*) Remove the wind triangle assembly as follows:

1. Take off the connector on the outside of the case by removing two screws.

2. Pull out the connector with the short shaft attached.

3. Remove the five mounting screws in the base of the wind triangle and take out the assembly.

(*s*) Remove the two spring clips from the idler gears and remove the gears.

(2) CLEANING, INSPECTION, TESTING, AND REPAIR.

(*a*) CLEANING.

1. After completely dismantling the wind drift mechanism, all parts, except electrical parts, should be thoroughly cleaned with a toothbrush dipped in any cleaning solvent following the Stoddard process (Federal Specification No. P-S-661).

2. Place the parts to drain and dry or dry them with compressed air if it is available.

3. As soon as any subassembly is thoroughly cleaned and dried, oil all ball bearings sparingly with instrument oil, Specification No. AN-0-6.

CAUTION

To prevent possible corrosion through use of the cleaning solvent, the bearings should be oiled as soon as each subassembly is dry.

4. Clean the electrical contacts of the electric follow-up motor with fine sandpaper.

CAUTION

The use of carbon tetrachloride as a cleaning agent should be avoided due to its corrosive action. However, if no other cleaner is available, carbon tetrachloride may be used, providing all ball bearings are oiled as soon as they are dry with instrument oil, Specification No. AN-0-6, and all other parts are wiped off with a clean cloth.

(*b*) INSPECTION.—Inspect all subassemblies and parts for evidence of wear or breakage.

(*c*) TESTING.

1. Test all subassemblies for freedom of movement and minimum backlash.

2. For a minimum of backlash the differentials should have full mesh on all gears.

(*d*) REPAIR.

1. Replace all parts showing wear or damage that cannot be satisfactorily remedied by adjustment.

2. If the gears of a differential show wear, it is sometimes possible to take up the backlash by shimming. This may be done by carefully driving out the pins and removing the shafts. Be careful not to spring the spider frames of the differentials out of true and, after shims are inserted, care must be taken to replace the gears in their original position.

(3) REASSEMBLY.

(*a*) Reassemble the wind triangle assembly.

(*b*) Install the remote control coupling and check for alignment and free turning.

(*c*) Install the ground-speed differential, securing close but free mesh with the idler gears.

(*d*) Install the air-speed carriage assembly as follows:

1. Check all movements of the wind triangle for free movement and full travel.

2. Check the pivot assembly at the bottom of the carriage for freedom of movement.

3. Replace the air-speed carriage support tracks.

4. Install the carriage to the upper splined shaft from an inverted position.

5. Place the air-speed carriage support track, next to the electric throttle, in position, locating the stop collar adjacent to the wind bar, using gage No. T9304. (Refer to Section IV, paragraph 3*m*(2) (*h*).)

6. Install the second track for the roller support.

(*e*) Locate the bar and stud assembly on the end of the wind drift unit frame and tap it into position in slots on each support track.

(*f*) Sliding the carriage assembly back and forth along the track, check that the upper splined shaft is so aligned that there is minimum movement of the end of the shaft. Any mis-alignment would be particularly noticeable at extreme positions of the carriage travel. See that there is no binding at any point of travel.

1. Adjustment is controlled by an eccentric nut on the side of the carriage roller bearing. This eccentric adjustment is locked by a setscrew that should be firmly tightened when satisfactory alignment is obtained.

2. Check the action of the ground-speed differential by rotating the splined shaft and checking for smoothness of operation.

3. Install the lower splined shaft, making sure that the ground-speed differential is in a level position, with the Bristo screw up, when the wind triangle rack housing is parallel with the upper splined shaft. There should be no bind or play in back and forth movement of the carriage or rotation of the splined shaft.

Note

Be sure the hole in the lower splined gear is in such a position as to reach the screws that hold the bearing in place. This may be accomplished by setting the pivot at one extreme position and lining up the hole in the gear with one of the screws.

4. Check the carriage in all positions of the lower splined shaft making sure there is no tendency to bind. A bind here may sometimes be corrected by loosening the three screws on the upper frame of the carriage and realigning it with the lower splined shaft.

(*g*) Install the wind-speed rack in the wind bar with the wind triangle rack located on the stud of the wind-speed rack. The wind-speed rack may go in from either end of the wind bar. Use the end which gives the best fit.

(*h*) Position the center of the pinion of the wind triangle differential 1-9/16 inches from the center of the pinion of the wind triangle pivot assembly, using gage No. T9304 (figure 109). Position the stop collar for the wind triangle pivot carriage.

(*i*) Set the zero wind velocity stop collar up next to the threads.

(*j*) Remove the intermediate gear of the wind triangle assembly. By turning the velocity control shaft, run the runner nut up to the stop collar, being certain that the milled slot of the runner nut is properly engaging the runner nut guide. By turning the gear of the wind triangle assembly, crank the wind slide assembly into a position where the wind slide stud will line up with the wind slide pinion of the wind triangle assembly. When this setting is obtained, mount the intermediate gear of the wind triangle assembly back into mesh. Check this alignment by revolving the wind bar rapidly and noting any movement of the wind triangle rack. If the wind slide stud is perfectly centered in relation to the wind slide pinion of the wind triangle assembly, there will be no movement of the wind triangle rack, which would be the zero wind setting.

(*k*) With the wind-speed rack stud in the center of the wind bar, scribe a line on the upper face of the bronze wind bar channel 15/16 in. from end of the wind slide rack toward the center of the wind bar, using gage No. T9307 (figure 109). Crank

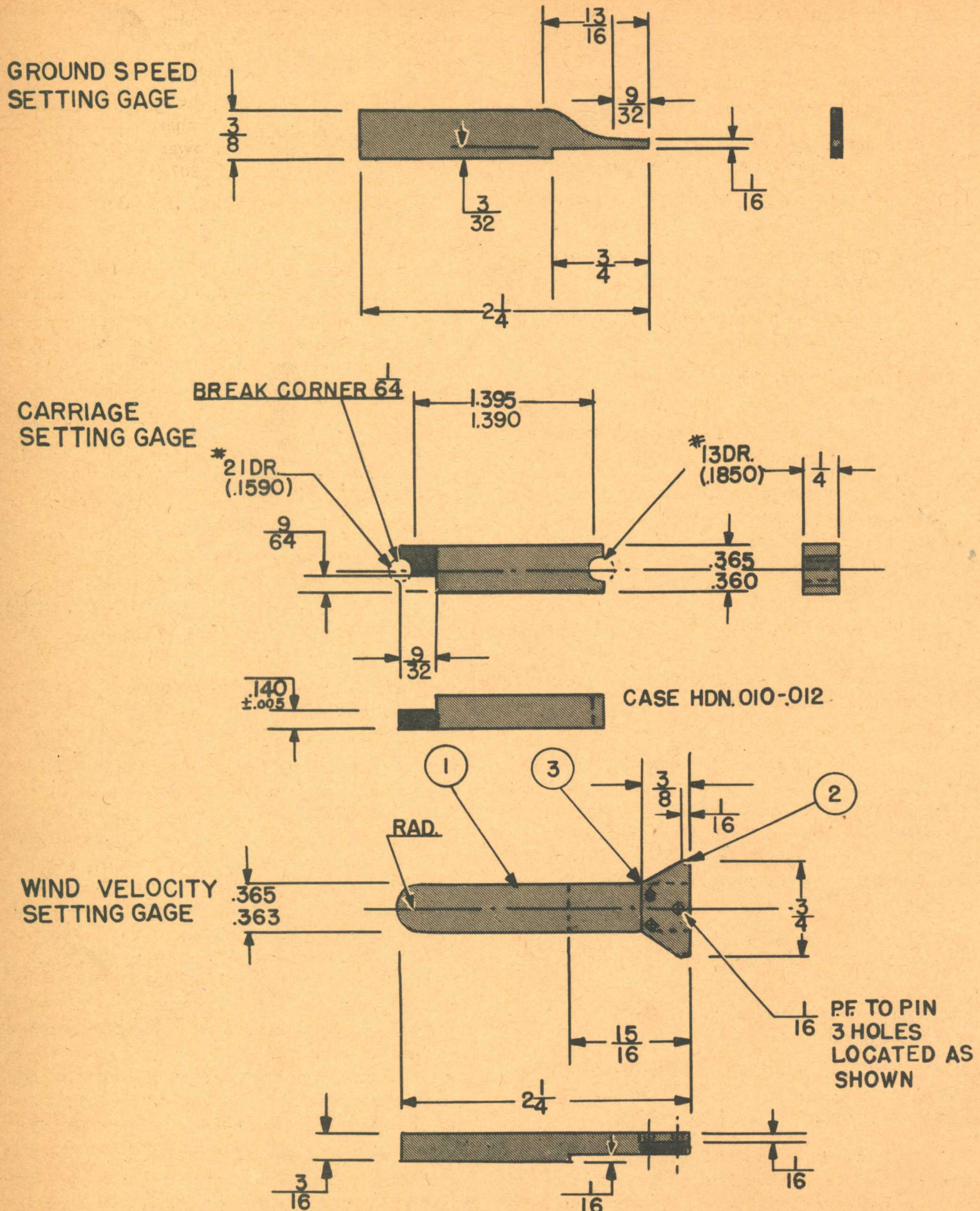


Figure 109—Wind Drift Adjustment Gages

the wind-speed slide until the line scribed on the wind bar is adjacent to the end of the wind-speed rack. Then adjust the stop collar against the runner nut and tighten the setscrew.

Note

The above procedure covers a 60-mile setting of the wind speed. If the runner nut does not stop positively against the pin in the stop collar, back off the collar until a positive stop is obtained.

(*l*) With the wind speed at 60 units, check all movements for free turning.

(*m*) Install the track differential assembly, controlling the gear mesh between the gear on the lower splined shaft and the gear on the track differential. See that the gears mesh so that there is no play and no bind when the wind bar is rotated with a full 60 mph wind. Make sure the track differential assembly shaft centers with the hole that receives the right-angle drive. If not, it may be necessary to shim the mounting surfaces of the track differential housing.

(*n*) Install the right-angle drive. Tighten the nut holding the right-angle drive enough to hold it in place securely. Tighten the two setscrews of the connector. The connector of the right-angle drive assembly may be tapped lightly to align it with the shaft of the track differential.

(*o*) Install the wiring assembly with the wire clips being sure the wire is neatly fitted. The flange of the A-N plug should be on the inside of the frame with the keyway on top.

(*p*) Check to see that the ground-speed cam assembly slides freely along the splined shaft of the cam assembly. Install the ground-speed cam assembly on the wind drift unit. With the wind velocity set at zero and the air-speed carriage assembly against the stop collar on the support track, align the right-hand edge of the cam roller in the same vertical plane as the center of the pinion shaft of the ground-speed differential assembly. Make certain that the bearing cap clamps the bearing without causing binding of the cam. Control the gear mesh between the ground-speed rack and the pinion by raising or lowering the bearing upon which the rack rides.

(*q*) Install the anti-backlash motor. Install the ground-speed motor, making sure there is proper mesh between the cam gear and the motor gear.

(*r*) Install the teletorque, making sure the coupling is meshed correctly. Hook up the wiring in accordance with wiring diagram, figure 123.

(*s*) Install the air-speed follow-up motor, and fit the brace to the follow-up motor making sure the locking nuts on the brace are drawn up evenly so that no strain is imposed on the follow-up motor.

(*t*) Install the control cable for the follow-up motor. This must be carefully done by winding the drum of the follow-up motor counterclockwise as far as the spring will allow it to go. Let the drum revolve slowly until the hole for installing the cable comes to the top of the drum. Holding the drum from turning, insert the cable through the hole in the wind-drift frame assembly and feed it underneath the follow-up motor drum pulley. Bring the cable up the pulley groove and through the hole in the pulley groove and tie a single knot in the extreme end of the cable. Grasp the cable outside of the frame and pull until the cable is holding all the spring tension of the drum pulley. Release slowly and the spring tension will wind the cable onto the drum.

(*u*) Install the micro switch contact points assembly. Solder up all connections. With the wind velocity set at zero and the air-speed carriage assembly against the stop collar of the support track, position the roller wheel of the micro switch 3/4 of an inch from the right-hand edge of the cam, using gage No. T9303. (See figure 109.)

(*v*) Install the wind direction differential assembly.

1. Be sure the gears are properly meshed and aligned.

2. Attach the direction control bracket with two screws.

3. Check the alignment.

(*w*) Assemble the base plate to the wind drift unit.

(*x*) Install the air-speed rack. This rack must line up with the drive gear of the electric throttle and the gears must be properly meshed. To install the air-speed rack, run the throttle as far as it will go in the direction that turns the drive gear, in the closed throttle position. With the carriage against the stop collar, mount the air-speed rack. It is often necessary to shim between the rack and the mounting on the carriage to secure alignment with the drive gear.

(*y*) Lubricate the wind drift mechanism sparingly, using medium grease, Specification No. VV-G-681, on the bevel gears, and instrument oil, Specification No. AN-0-6, on other gears and moving parts.

CAUTION

The follow-up motor does not require lubrication.

(*z*) Replace all covers.

n. VACUUM TURBINE. (*See figure* 110.)

(1) DISASSEMBLY.

(*a*) Place the turbine on a bench and remove all bolts from the end head and carefully pull the head and the gasket from the housing.

(*b*) Turn the shaft to a position where the impeller clamp bolts are vertical and scribe a reference mark from the center of the shaft upward.

(*c*) Place an identifying number or letter on the top of each impeller and deflector as it is removed. Keep the mark on the end of the shaft vertical when marking impellers. These marks will make it possible to reassemble the parts in their original position, thus insuring that the motor balance will be maintained.

Note

Do not pull on the outside of the impellers when removing them. Handle these by the hubs in all cases as they are very easily bent.

(*d*) Loosen the clamp nuts and pull the first impeller from the shaft.

(*e*) Remove the deflector spacer noting that the flange is on the inside, covering the rope packing.

(*f*) Remove the rope packing.

(*g*) Remove the deflector, after marking for reassembly.

(*h*) Continue to remove impellers, spacers, rope packings, and deflectors until the last impeller is removed. Note that the last deflector and spacer are different from the others.

(*i*) Remove the division head packing.

(*j*) Do not disturb the four large flathead screws holding the motor flange to the division head.

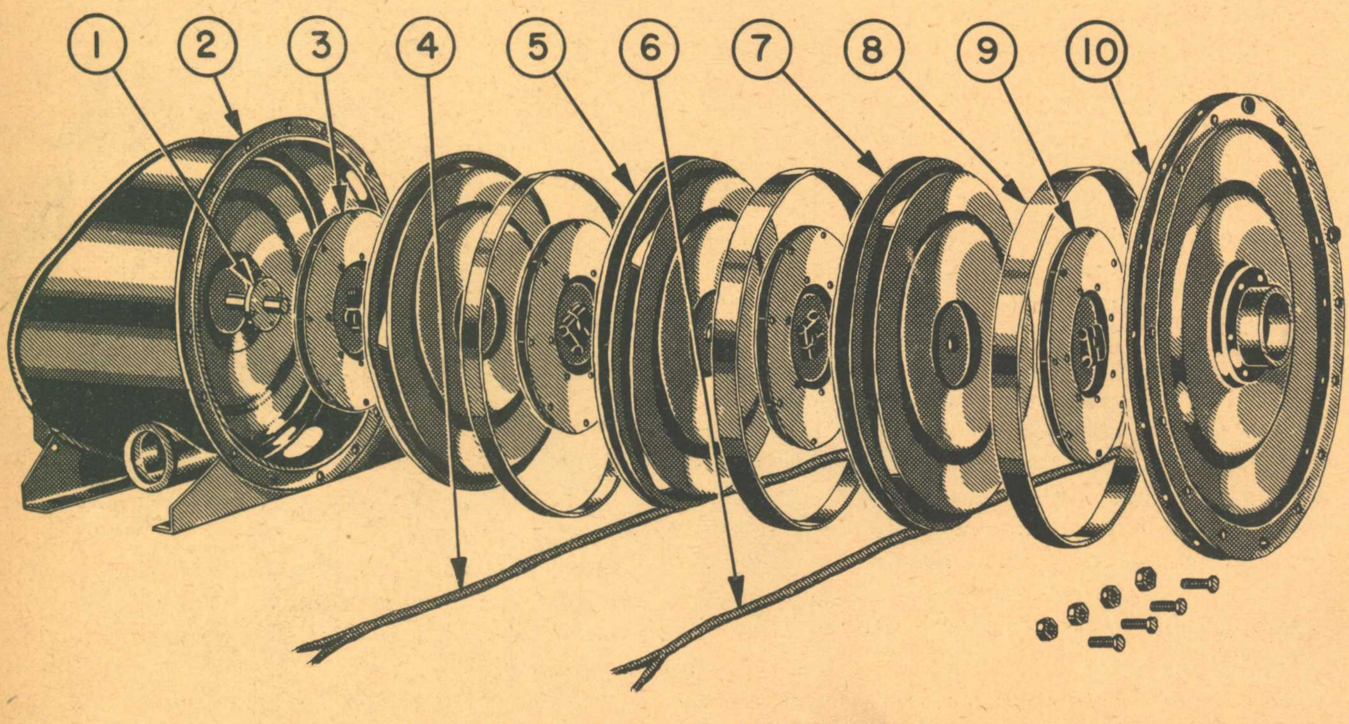


Figure 110—Vacuum Turbine (Exploded View)

1. Packing
2. Division Head
3. Head Spacer
4. Packing
5. Deflector Head
6. Packing
7. Deflector Head
8. Head Spacer
9. Impeller
10. Gasket

(*k*) Remove the entire motor by taking off four hex nuts which hold the rear end housing to the flange.

(*l*) Remove the brush covers, holders, and brushes, marking each part so that it can be replaced in its original position.

(*m*) Push the wire leads through the holes in the end bell.

(*n*) Remove the four screws in the front end of the end bell and tap out the bearing housing flange.

(*o*) Remove the hex stud and the washers holding the front bearing. (The stud has a right-hand thread.) Place a screw driver or similar tool against the fan blades to hold the armature.

(*p*) Scribe a mark across the end bell and the field shell as a reference for reassembly. Remove the four long hex bolts holding the end bell and field assembly to the rear housing. Remove the end bell by tapping it with a piece of wood.

(*q*) Remove the armature and the rear end housing from the field, and from each other.

(*r*) Note the position of the spring thrust washer in the rear end housing before removing, so that it may be replaced in the same position.

(*s*) Remove the front bearing, which will come off readily with the end bell, but the rear bearing must be removed with a puller.

CAUTION

Make sure the puller is pulling straight on the shaft as the shaft is very easily bent.

(*t*) Remove the flathead screws in the rear housing and remove the plate.

(*u*) Remove the felt grease retainer in the plate by placing an offset screw driver or similar tool under it and tapping out gently.

(*v*) If any grease is noticed at the rear of the housing, a new felt retainer should be installed. It is advisable to replace the felt retainer during every overhaul, regardless of its condition.

(*w*) Remove the grease cup caps and drain plugs and blow out the holes with air.

(2) CLEANING, INSPECTION, AND REPAIR.

(*a*) Wash all parts except the field, armature, and brushes with cleaning solvent, Federal Specification No. P.S. 661, or carbon tetrachloride, U. S. Army Specification No. 4-503-110B.

(*b*) The rear bearing may be washed while on the shaft; do not allow the cleaning compound or grease to get on the armature winding. Place the bearings in a clean place to dry, or dry them with compressed air.

(*c*) Inspect the bearings for roughness and wear. Install new bearings where necessary.

(*d*) Lubricate the bearings with grease, Specification No. AN-G-5, as soon as they are dry.

(3) MOTOR—REASSEMBLY.

(*a*) Press the bearing on the rear of the armature shaft. If it cannot be pressed on the shaft, a piece of pipe or tubing can be slipped over the shaft and the bearing can be driven on. Protect the bearing with a soft metal or fiber washer while driving it on the shaft. Avoid getting dirt in the bearings at all times.

(*b*) Repack rear bearing and housing with grease, Specification No. AN-G-5, or Lubriko M-6, supplied by the Spencer Turbine Company.

(*c*) Reassemble the remaining parts in the reverse order of that given in the disassembly instructions, and mount the completed motor to the division head.

(*d*) Leave the drain plugs out until after greasing. (Refer to paragraph 3*n*(5) of this section.)

(4) TURBINE—REASSEMBLY.

(*a*) Wipe out all dust from the interior of the turbine. Thoroughly clean the deflectors and impellers.

(*b*) Check the division head packing felt. If it fits loosely on the shaft, or if there are indications of grease on the impeller side of the packing, replace it with a new part.

(*c*) Place the inside impeller on the end of the shaft and tighten it until it will just slide freely. Rotate impeller by hand to see that it runs true. If not, straighten any slight variations by bending *carefully*.

CAUTION

Do not attempt to use a badly bent or damaged impeller as this will cause excessive vibration and may result in serious damage.

(*d*) Push the impeller on the shaft to approximately 1 inch from the inside.

(*e*) Place the inside deflector in the unit and push the impeller and deflector until the deflector rests firmly against the spacer.

(*f*) Mark the shaft at the impeller hub with a scriber or colored pencil and remove the deflector.

(*g*) Push the impeller in as far as it will go and note a halfway position from the hub to the scriber mark. Return the impeller to this halfway position and tighten the clamp nuts evenly.

(*h*) Return the deflector to the unit and install the next spacer.

(*i*) Place the next impeller on the shaft and proceed as before.

(*j*) Caulk in the rope packing with a caulking iron or screw driver, stretching or compressing the packing as required to obtain an overlap at the ends of about 1/2 inch.

(*k*) Continue in this manner until all impellers, spacers, deflectors, packings, end head gasket, and head are installed.

(5) MOTOR—LUBRICATION.

(*a*) The turbine and motor should be warm and should be kept at operating speed during the lubrication process.

(*b*) Inject grease, Specification No. AN-G-5, or Lubriko M-6, with a grease cup or pressure gun until grease appears at the drain plug opening.

(6) TESTING VIBRATION AND SPEED.

(*a*) In installing new impellers it is the general practice to align all clamp bolts parallel to each other. This alignment may be changed (especially on the end impeller) if necessary to eliminate vibration.

(*b*) The speed and, consequently, the output of this unit may be changed, within small limits, by loosening the four bolts which hold the front end bell and slightly rotating the end bell. Rotate the end bell in a clockwise direction (facing the commutator end) to increase the speed; counterclockwise, to decrease. This adjustment is necessary, only if the turbine is operated at above, or below, normal voltage. (See figure 122.)

o. TELEGON OSCILLATOR. (*See figure* 111.)

(1) Remove the telegon oscillator from its case. Inspect all wiring. See that all soldered joints are clean and unbroken.

(2) Tighten all screw terminals.

(3) Replace all old wiring with new wherever there is evidence of deterioration.

(4) Replace the telegon oscillator in its case.

p. SPINDLE AND COLLECTOR RINGS. (*See figure* 112.)

(1) DISASSEMBLY.

(*a*) Place the bearing housing in a vise with the collector ring brush bracket uppermost.

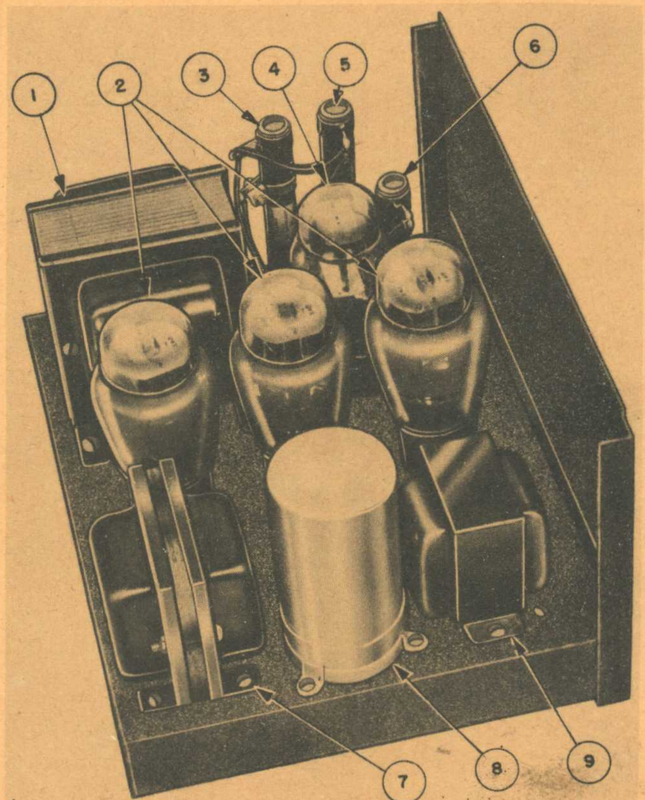


Figure 111—Telegon Oscillator

1. *Power Transformer*
2. *6L6G Radio Tubes*
3. *Resistor, adjustable, 750 ohms—50 watt*
4. *83V Radio Tube*
5. *Resistor, 500 ohms—50 watt*
6. *Resistor, 1000 ohms—25 watt*
7. *Output Transformer*
8. *Capacitor, 4 mfd*
9. *Oscillation Transformer*

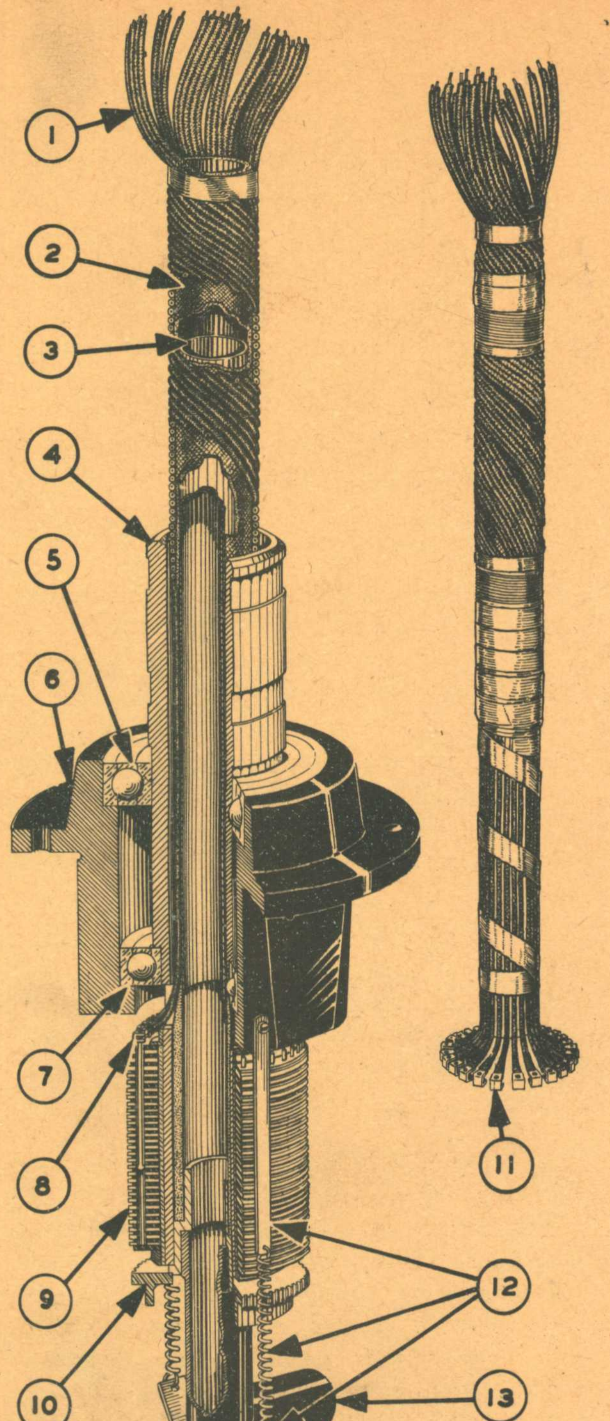


Figure 112—Spindle and Collector Rings

1. *Spindle Wiring*
2. *Rubber Tubing*
3. *Metal Core*
4. *Spindle*
5. *Upper Bearing*
6. *Bearing Housing*
7. *Lower Bearing*
8. *Collector Ring Terminals*
9. *Collector Rings*
10. *Autosyn Pick-up Gear*
11. *Wiring Assembly*
12. *Conductor Elbow Hanger*
13. *Conductor Elbow*

(*b*) Remove the two capscrews from the collector ring brush bracket and remove the bracket and brushes from the bearing housing casting.

(*c*) Spring the bracket from the transfer elbow and remove the round-head screws holding the sling spring assembly bracket to the bearing housing casting.

(*d*) Remove the transfer elbow from the gear hub.

(*e*) Remove the two long screws from the drive gear, releasing the drive gear and gear hub from the hollow shaft.

Note

Two short screws hold the drive gear to the gear hub, while alternating with these are the two longer screws attaching the gear and hub to the hollow shaft. In order to determine which set of screws is being removed, take out one screw. If this proves to be a long screw (1/2-inch) proceed with the removal of the opposite screw. If this screw proves to be a short screw (3/16-inch) replace it and remove the opposite pair.

(*f*) Pull out the drive gear and the gear hub and remove the two short screws.

(*g*) Remove the terminal clips from the collector ring poles by placing a small size screw driver between the clips and the top insulation ring and prying the clips off, or they may be pulled off with long-nose pliers.

(*h*) Remove the two screws holding the collector rings to the hollow shaft and slide the rings off the shaft.

(*i*) Push the three groups of wires inside the hollow shaft.

(*j*) Remove the tubing and wires from the hollow shaft.

Note

On all trainers, beginning with Link Serial No. 5020, the radio compass teletorque bracket is installed on the bearing housing casting and is disassembled by the removal of two hex head screws.

(*k*) Remove the bearing housing casting from the vise.

(*l*) Remove the hollow shaft from the bearing housing by tapping the small end of the shaft on the floor.

Note

In tapping the hollow shaft on the floor to remove the bearing housing and bearings, and to reassemble these parts, care should be used to select a clean spot and not to damage the machine finished ends of the shaft. A block of wood should be used on concrete or metal floors.

(*m*) If one or both bearings come out with the hollow shaft, remove the bearings from the shaft by tapping them with a fibre mallet.

(*n*) If the bearings do not come out of the bearing housing casting with the hollow shaft, place the shaft on the floor with the small end down and drop the housing containing the bearings (small end of the housing down) over the hollow shaft and they can be jarred out without damage.

(2) CLEANING, INSPECTION, TESTING, AND REPAIR.

(*a*) CLEANING.

1. Wash the housing, shaft, and unsealed bearings in cleaning solvent, Federal Specification No. P.S. 661, or equal.

Note

If the bearings are sealed, merely wipe off the outer surface.

2. Remove all abrasions and dirt from the collector rings with fine sandpaper or crocus cloth.

(*b*) INSPECTION.

1. Inspect the bearing housing and hollow shaft for defects. Install new parts where necessary.

2. Inspect the bearings for freedom of operation. If the bearings bind, replace with a new bearing assembly.

3. Inspect the collector ring assembly for tightness.

(*c*) TESTING.—Test the collector ring assembly for shorts with an ohmmeter. This is done by checking each ring against the others. Check for open circuits between each ring and its respective terminal. If a short exists, check for metallic particles between the rings.

Note

If the short is within the unit, a new collector ring assembly should be installed.

(*d*) REPAIR.—If the collector rings have any deep abrasions, place the assembly in a lathe and finish off the surface. If cuts are too deep for repair, replace the entire collector ring assembly.

(3) REASSEMBLY.

(*a*) Place the larger, upper bearing over the hollow shaft and push down until it seats.

(*b*) Repeat the same procedure with the smaller lower bearing.

(*c*) Place the hollow shaft, with bearings, on the floor with the small end of the hollow shaft up and then drop the bearing housing casting into place and firmly jar the bearings home.

(*d*) Place the bearing housing casting flange in a bench vise with the assembled shaft parallel with the front edge of the bench and with the small end of the shaft to the right. Also see that the larger of the two flat areas on the bearing housing is uppermost.

(*e*) Place the spindle wiring assembly into the large end of the hollow shaft, terminal clips first. Push the assembly through the shaft until the terminal clips reach the three ports on the hollow shaft below the housing.

Note

If the spindle wiring assembly shows signs of wear or deterioration, replacement of the entire wiring assembly is recommended. The spindle wires are numbered from left to right, or clockwise, No. 1 through No. 28, starting at the open space between the wires when one faces the small end of the hollow shaft. No. 1 wire should be marked at both ends to facilitate identification. Facing the small end of the hollow shaft, the first group of wire terminals, beginning with No. 1, should be pulled out through the port to the right of the partition beneath which appears one of the two tapped holes used in attaching the collector rings to the hollow shaft. Each group comes out through each successive port in a clockwise direction.

(*f*) Pull all the leads through the ports by bringing leads, Nos. 1 to 10 through the first port, Nos. 11 to 19 through the second port, and Nos. 20 to 28 through the third port.

(*g*) Attach the collector ring assembly to the hollow shaft with the two screws.

(*h*) Raise the wires so that the terminal clips will rest on the collector ring poles.

Note

No. 1 clip goes on the first pole to the right of the screw in the partition between the ports, and the rest of the clips follow in numerical order.

(*i*) Install the clips attached to the wire leads on the collector ring poles by forcing them down with two small screw drivers or a pair of long-nose pliers.

Note

If the clips are bent, they should be straightened with pliers before forcing them on the collector ring poles.

(*j*) Insert the short length of rubber tube over the metal tubing in the collector ring end of the spindle, taper end first.

(*k*) Place the drive gear on the gear hub, securing it with two 3/16-inch 8-32 screws.

(*l*) Insert the gear hub in the hollow shaft on the collector ring end making sure the holes line up with the holes in the hollow shaft. Push in firmly until the hub rests on the end of the hollow shaft. Insert two 1/2-inch 8-32 screws and see that the screw heads are filed flush with the inside of the hub.

Note

Use a half-round file for this purpose and be sure to wipe the inside of the shaft clean of filings.

(*m*) Install the collector ring brush bracket and tighten the screws holding the bracket to the bearing housing casting. Line up the brushes so that each brush rides in the middle of its collector ring.

Note

If the brushes are bent to one side or the other, pry them over with a screw driver until all are properly aligned.

CAUTION

Care should be taken not to scratch the collector rings.

(*n*) Fasten the transfer elbow hanger sling spring assembly to the bearing housing casting with two 3/4-inch 8-32 screws. Oil the springs to prevent rusting. See that the straps are parallel with the shaft before tightening the screws.

(*o*) Apply grease around the unpainted end of the transfer elbow. Insert the greased end of the elbow into the gear hub and place the hanger over the small protruding end on the bottom of the transfer elbow.

(*p*) On trainers, beginning with Link Serial No. 5020, attach the automatic radio compass teletorque bracket to the smaller flat surface on the bearing housing with two 5/8-inch 1/4 x 20 hex head screws.

q. AUTOMATIC RECORDER.

(1) DISASSEMBLY OF RECORDER. (*See figure* 113.)

(*a*) Place the recorder upside down on a bench, resting on its handle. Remove the five screws on the bottom of the teletorque unit and remove the seven wires. Replace the screws and washers to the teletorque unit so they will not be lost.

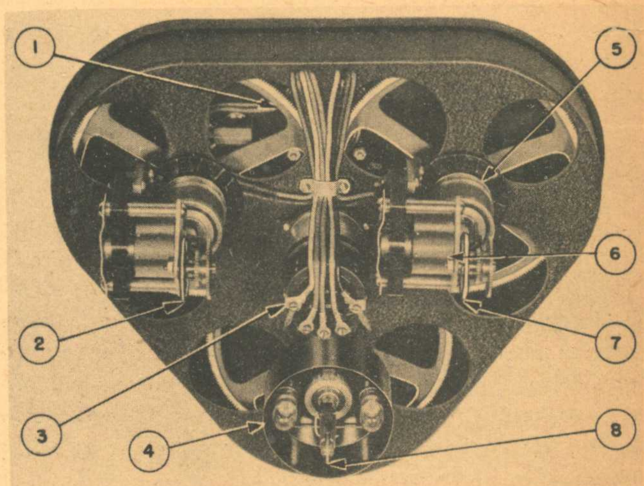


Figure 113—Automatic Recorder (bottom view)

1. *Heading Gear*
2. *Drive Wheel*
3. *Directional Teletorque Motor*
4. *Light Assembly*
5. *Collector Assembly*
6. *Synchronous Telechron Motor*
7. *Drive Wheel*
8. *Inking Wheel*

(*b*) Remove the light assembly from the inking wheel spindle housing by sliding the light housing off the bearing housing. Disconnect the light-wire terminals.

(*c*) Remove the wires connected to the collector assembly by pulling back the transparent shielding, and unsoldering the spliced wires.

(*d*) Remove the wire clamp near the teletorque motor.

(*e*) Turn the recorder right side up and remove the thumb-screw and the radio compass off-course pointer. (See figure 6.)

(*f*) Remove the recorder cover plate, switch, receptacle plug, and connecting wires as one unit, by unscrewing the three cover plate mounting screws.

(*g*) Remove the two Bristo setscrews on each of the large teletorque heading gears. Lift out the three gears one by one.

(*h*) This exposes the three round head machine screws which hold the teletorque motor in place. Remove these screws and pull the teletorque motor out of the recorder bed plate.

(*i*) Turn the recorder bed plate up on its side and place a piece of paper between the brushes on one of the telechron motor assemblies and the collector rings. Grasping the motor in one hand, pull it gently but firmly away from the frame. If the motor will not come away, tap the top of the shaft gently to release it. Remove the opposite telechron motor in the same manner.

(*j*) Remove the inking wheel spindle assembly in the same manner as the telechron motors.

(*k*) Remove the two collector ring and housing assemblies by taking out the machine screws that hold these units to the recorder frame. The ball bearings in the collector ring housing are press fit. Do not remove them unless they appear to be defective. To remove the collector assembly from the bearing housing, remove two 5-40 setscrews with a No. 5 Bristo wrench and remove the housing by pressing on the bearing.

(2) DISASSEMBLY OF TELECHRON MOTOR. (*See figure* 113.)

(*a*) Remove the two round head machine screws from the wheel base assembly.

(*b*) Remove the wires connecting the motor to the brush assembly with a soldering iron.

(*c*) Remove the spring clip. Remove the setscrews from the pinion gear and remove the pinion gear and drive gear at the same time.

(*d*) Lift the telechron motor out of its housing.

(*e*) Remove the brush assembly by taking out the two round head machine screws from the bottom of the brush.

(3) CLEANING.

(*a*) Clean the following parts, by dipping them in dry cleaning solvent, Federal Specification No. P.S. 661, and dry them with compressed air:

1. Large gears
2. Bearing housing
3. Motor spindle and gears
4. Inking wheel and spindle

Note

If an air hose is not available, cheese cloth may be used for drying purposes.

(*b*) Place the bearings on a screen of fine mesh wire and dip four or five times in the cleaning solvent. Place the bearings on a paper towel to dry.

CAUTION

Do not use an air hose on bearings for drying purposes.

(*c*) If the brushes on the motor are discolored or corroded, clean them with fine emery paper.

(4) INSPECTION, REPAIR, AND TESTING OF TELECHRON MOTOR.

(*a*) Inspect the wiring for evidence of wear or deterioration. Replace with new wire as required.

(*b*) Inspect the brushes for evidence of wear. Replace with new brushes where required.

(*c*) Replace all damaged screws and wiring.

(*d*) Test the motor with 110-v leads applied to the terminals on the field coil.

(5) TELECHRON MOTOR—REASSEMBLY.

(*a*) Replace the two machine screws in the brush assembly.

(*b*) Line up the brushes with the rings by the use of the two adjusting screws.

(*c*) Replace the wheel assembly by slipping the wheel on the shaft. Replace the pinion gear on the motor. Tighten the setscrew on the pinion gear and replace the spring clip.

(6) RECORDER—INSPECTION AND REPAIR.

(*a*) Clean all recorder gears carefully and check for tooth wear which may give faulty operation.

(*b*) Inspect the collector ring assemblies; clean and polish if worn or rough.

(*c*) Check all bearings for wear which might affect the proper tracking of the recorder.

(*d*) Replace all worn or damaged parts. Refinish the painted parts of the recorder frame and cover as required. All wiring should be replaced at reassembly if the insulation is worn or is not fresh and pliable. (For wiring the recorder, see figures 126 and 127.)

(7) RECORDER—REASSEMBLY.

(*a*) Place the recorder bed plate upright in a vise, protecting it with two pieces of felt. Do not tighten the vise jaws too much, as this will cause damage to the bed plate.

(*b*) Install the teletorque motor in the center hole of the bed plate, with its wiring terminals facing the front of the recorder, and secure it in place with three 6-32 round head screws.

(*c*) Install the inking wheel bearing housing, securing it with three 4-36 round head screws.

(*d*) Install the two collector ring assemblies in the bed plate, securing each one with three round head machine screws.

(*e*) Install the two telechron motor assemblies in the collector ring housing. Be careful not to damage collector rings when installing telechron motors. Damage may be prevented by inserting a piece of stiff paper between the collector rings and the telechron motor brushes during the installation of the telechron motors.

(*f*) Remove the recorder bed plate from the vise and place it upright on a work bench. Install the brass washers on the inking wheel shaft and on each of the telechron motor shafts.

(*g*) Place two gears on the telechron motor shafts, tightening the setscrews on *only one of the gears.*

(*h*) Take the third large teletorque driving gear and place it in position on the inking wheel shaft. Secure it in position by tightening the Bristo setscrews. See that the gear turns freely through 360 degrees.

(*i*) With the three gears installed, align the two drive motors by placing a straightedge against the drive motor wheels as shown in figure 114. With the drive wheels aligned, tighten the setscrews that were left loose on the third gear.

(*j*) Align the inking wheel by placing the straightedge against one of the drive wheels and the inking wheel, using the side of the drive wheel which is away from the driving gears. (See figure 114.) The two wheels should be flat against the straightedge. If the inking wheel is out of alignment, loosen the setscrews on the large gear fastened to the inking wheel shaft and turn the inking wheel by hand until it is flat against the straightedge, then tighten the setscrews on the inking wheel gear.

(*k*) Install the cover plate on the recorder frame. Pull the wires to the teletorque and telechron motors through the rear part of the recorder bed plate. Secure the cover plate with three machine screws.

(*l*) Turn the recorder upside down resting it on its handle and the edge of the bed plate, and wire up the lights, telechron, and teletorque motors.

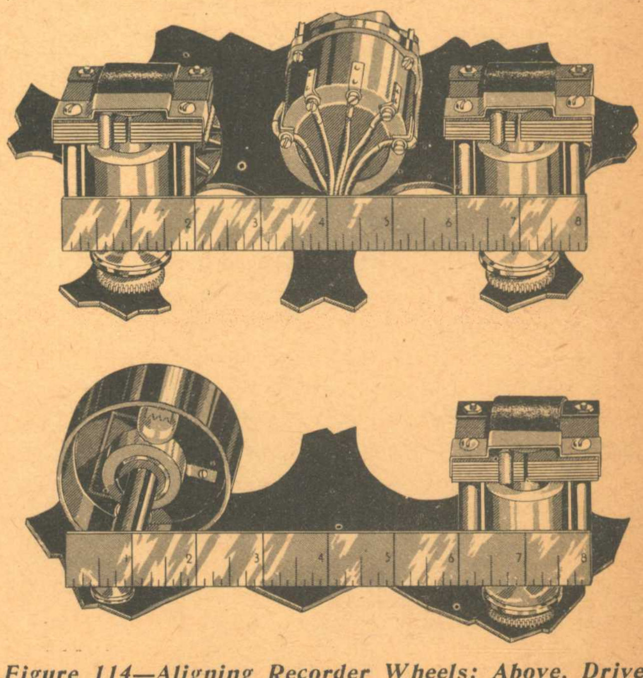
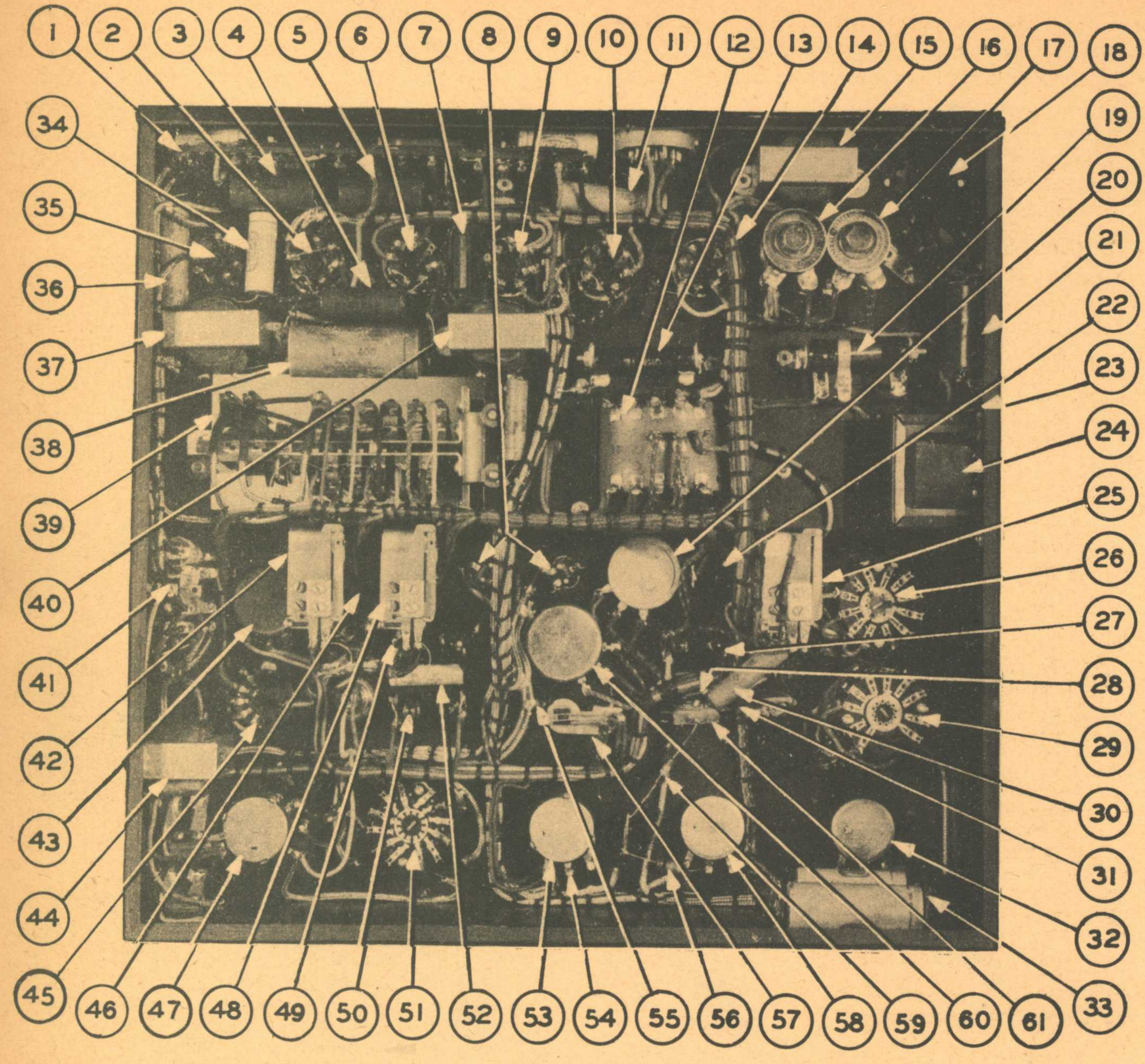
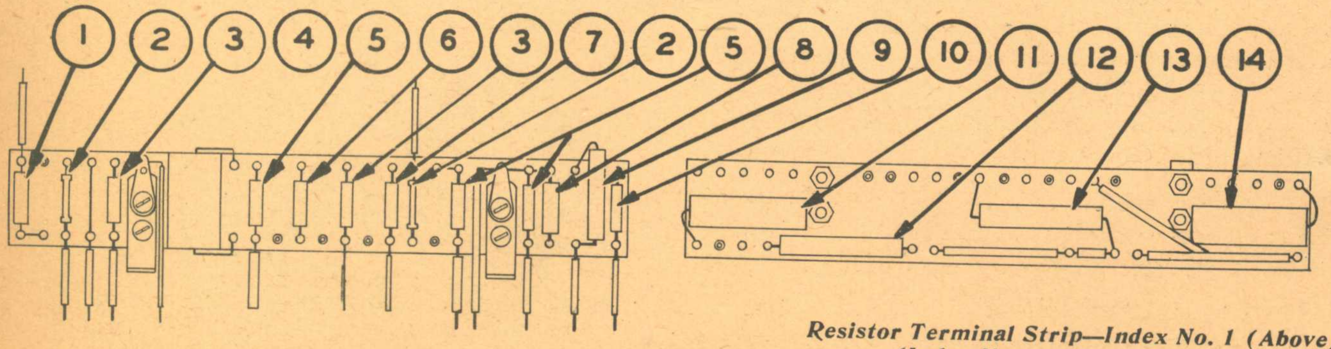


Figure 114—Aligning Recorder Wheels: Above, Drive Wheels; below, Drive Wheel and Inking Wheel





Resistor Terminal Strip—Index No. 1 (Above)
(Index Nos. on Opposite page)

Figure 115—Radio Control Chassis (Back View)
(See reference list on opposite page)

Double-check the wiring connections before turning the recorder right side up. (See figures 126 and 127.)

Note

The recorder cannot be satisfactorily tested until the trainer is completely assembled. For test procedure, refer to Section V, paragraph 21.

r. RADIO AND COMMUNICATION SYSTEM.

(1) RADIO CHASSIS (INCLUDING KEYER). (*See figure* 115.)

(*a*) CLEANING, INSPECTION, TESTING, AND REPAIR.

1. Remove dust or dirt with a soft brush or compressed air.

2. Inspect all wiring for evidence of deterioration and see that all soldered joints are clean and unbroken. Wires that have been installed outside the cable assemblies should be tied into their proper assembly.

3. Tighten all screw terminals.

4. Inspect all insulation to see that it has not deteriorated, but is firm and pliant.

5. If any of the units or circuits have failed to function properly, a thorough and careful inspection should be made to be certain all connections are tight and all plugs are in their proper places.

Figure 115—Radio Control Chassis (Back View)

1. *Resistor Assembly Terminal Strip (Detail at Left)*
2. *Socket, 8 Contact Black Bakelite—6N7 Tube*
3. *Capacitor—Electrolytic 25 mfd 25 Volts*
4. *Capacitor—Electrolytic 25 mfd 25 Volts*
5. *Capacitor—Electrolytic 25 mfd 25 Volts*
6. *Socket, 8 Contact Black Bakelite—6V6 GT/6 Tube*
7. *Capacitor—Paper .01 mfd 400 Volts*
8. *Potentiometer, 500,000 Ohms—Slotted Type*
9. *Socket, 8 Contact Black Bakelite—6N7 Tube*
10. *Socket, 8 Contact Black Bakelite—6C5 Tube*
11. *Capacitor—Paper .02 mfd 400 Volts*
12. *Power Transformer C-5 Trainer*
13. *Resistor—Wire Wound—50,000 Ohms*
14. *Socket, 8 Contact Black Bakelite—5Y3 Tube GT/G Radio*
15. *Transformer—Noise Amplifier Input*
16. *Rectifier—Copper Oxide G.E.*
17. *Rectifier—Copper Oxide G.E.*
18. *Plug—1¼ in. Hole Button*
19. *Resistor—Wire Wound, Adjustable 1500 Ohms 25 Watt*
20. *Potentiometer—Wire Wound—200 Ohms*
21. *Capacitor—Electrolytic 50 mfd 50 Volts*
22. *Power Switch (Keyer)*
23. *Resistor—1000 Ohms ½ Watt*
24. *Choke Filter*
25. *Relay—Visual Marker*
26. *Army-Navy-British Switch*
27. *Power Switch (Landing Instrument)*
28. *Resistor—500 Ohms ½ Watt*
29. *Marker Selector Switch*
30. *Resistor—Wire Wound—100 Ohms 10 Watt*
31. *Resistor—1000 Ohms ½ Watt*
32. *Potentiometer—50,000 Ohms*
33. *Capacitor Assembly (Front to Back): 1 mfd, .2 mfd, .1 mfd, .005 mfd, .0015 mfd, .00025 mfd, .01 mfd*
34. *Capacitor—Paper—.1 mfd 400 Volts*
35. *Socket, 8 Contact Black Bakelite 6C5 Tube*
36. *Capacitor, Paper—.2 mfd 400 Volts*
37. *Transformer—Oscillator*
38. *Capacitor—Paper—1 mfd 400 Volts*
39. *Keyer Assembly*
40. *Transformer—Oscillator*
41. *Cable Assembly—Duplex Shielded Relay: Capacitor, paper, .1 mfd 400 V; Resistor, 15,000 Ohms, ½ Watt; Capacitor, paper, .03 mfd 600 V; Capacitor, mica, .002 mfd 1000 V; Resistor, 100,000 Ohms, ½ Watt; Resistor, 30,000 Ohms, ½ Watt*
42. *Relay Marker Selector*
43. *Potentiometer—25,000 Ohms*
44. *Transformer—Microphone Input*
45. *Switch—Identification Selector*
46. *Resistor—100 Ohms 10 Watt—Wire Wound*
47. *Control Beam Shift Type D*
48. *Relay Marker Selector*
49. *Power Switch (Instrument Landing Marker)*
50. *Power Switch (Visual Marker)*
51. *Switch—Selector 3 Circuits—One Section*
52. *Capacitor—.02 mfd 600 Volts—Paper*
53. *Potentiometer—250,000 and 1500 Ohms*
54. *Resistor—100,000 Ohms ½ Watt*
55. *Resistor—10,000 Ohms ½ Watt*
56. *Resistor—500,000 Ohms ½ Watt*
57. *Switch—Visual Marker Beacon*
58. *Potentiometer—50,000 Ohms*
59. *Resistor—1 Megohm ½ Watt*
60. *Potentiometer—200 Ohms*
61. *Switch—Toggle D.P.D.T.*

Resistor Terminal Strip
(See Figure 115)

1. *Resistor 50,000 ohms ½ Watt*
2. *Resistor WW 200 ohms 1 Watt*
3. *Resistor WW 700 ohms ½ Watt*
4. *Capacitor, paper, .01 mfd, 400 Volts*
5. *Resistor 100,000 ohms ½ Watt*
6. *Resistor WW 400 ohms ½ Watt*
7. *Resistor 10,000 ohms ½ Watt*
8. *Resistor 500,000 ohms ½ Watt*
9. *Resistor 7500 ohms 1 Watt*
10. *Resistor 25,000 ohms ½ Watt*
11. *Capacitor, paper, .02 mfd, 600 Volts*
12. *Resistor 25,000 ohms, 2 Watt*
13. *Resistor 80,000 ohms 2 Watt*
14. *Capacitor, paper, .1 mfd, 400 Volts*

6. Check the radio against the wiring diagrams. (See figures 52, 53, 126, and 127.)

7. Replace any units or wiring found to be defective.

(2) RADIO RANGE KEYER. (*See figure* 57.)

(*a*) LUBRICATION.—Apply a small drop of oil, Specification No. AN-0-6, to each moving part except the cams and cam followers. Lubricate sparingly and wipe off any excess oil.

CAUTION

The knurled knob on the extreme right-hand end of the keyer is part of the cam shaft assembly bearing pin and has a left-hand thread. To remove, it must be turned to the right. The cam shaft or gears should never be turned backwards by hand because of danger of damaging cam followers.

(*b*) ADJUSTMENT OF CONTACTS.

1. One of the A–N points should make contact just as the other is breaking. There should be no overlap, yet there must be no interval between the opening of one contact and the closing of the other.

2. Both fixed contacts should just barely be touching the movable contact when the cam follower is just half way between the high and low parts of the cam. Another check on the adjustment is to see that when the follower is at the low part of the cam, the fixed point which is making contact is pushed away from the adjusting screw head the same distance as the other movable contact is from its screw head, when the follower is on the high part of the cam.

3. The final test is to listen to the signal with the beam shift control in the "ON COURSE" position and the beam volume set at about 60. No clicks should be heard. If the on course signal is not an even tone, back off one of the A–N contact adjusting screws until there is a definite break in the signal; then, screw it in again until the key click just barely disappears.

4. Adjust all other contacts so there is an air gap of 1/32 inch between the points when the cam follower is on the highest part of the cam.

(*c*) TIMING OF CAMS ON CAMSHAFT ASSEMBLY. (*See figure* 58.)

1. If the cams are removed and replaced, the spacing between cams must be established as before. Each cam has a spot on one side to assist in timing. Ordinarily the cam is placed on the shaft with this spot away from the gear. There are two keyways in each cam so it is necessary to know which one to use. Each cam must use the keyway which, when the spot on one cam lines up with the follower of that cam, permits all other spots to line up with their respective cam followers. Since the cam followers are staggered, the spots will also be staggered.

2. In some cases, one cam will produce a different pair of call letters if it is reversed. To do this, simply turn the cam over so the spot is toward the gear but with the spot still lined up with its own cam follower.

(*d*) MOTOR POSITION AND DRIVE GEARS.

1. If the motor should be removed for any reason, or its clamp screws should become loosened, adjust its position to obtain proper mesh between the gear on the camshaft and the heavy pinion which drives it.

2. The motor mounting screws are in slots which permit the motor and gear train to be raised or lowered as a unit. Raise or lower this unit as required to make the camshaft gear and its drive pinion mesh without undue slack, yet so they do not bind. The pivot of the small reduction gear also moves up or down with the motor assembly, in a slot in the keyer frame. Care should be exercised to avoid damage to this pivot, while making adjustments.

CAUTION

Do not make unnecessary changes of adjustments. The design and material of this unit are such that adjustments will seldom be necessary if it is not disturbed other than for cleaning, lubrication, and normal handling in the changing of cam assemblies. The unit should remain balanced if it is properly balanced during overhaul.

s. AIR FILTERS.

(1) TURN AND BANK INDICATOR FILTER. (*See figure* 116.)

(*a*) DISASSEMBLY.

1. Unscrew the filter from the turn and bank indicator.

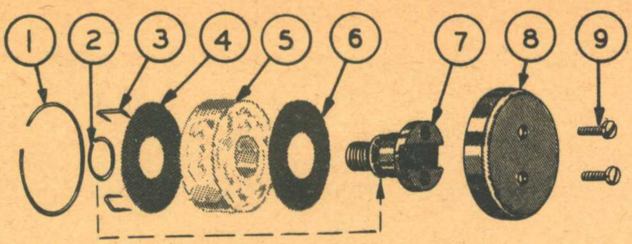


Figure 116—Turn and Bank Indicator Filter

1. Expander Ring
2. Compressor Ring
3. Staples (3)
4. Screen
5. Cotton Filler
6. Screen
7. Orifice Stud
8. Filter Housing
9. Filter Housing Screws (2)

2. Remove the two small screws from the face of the filter housing.

3. Remove the retaining ring from the back of the filter housing and remove the screens and the center orifice stud.

4. Remove the small spring clip compressor ring from the center orifice stud and take the screens and the cotton filler off.

5. Remove the staples and separate the screens from the cotton.

(*b*) CLEANING AND REPAIR.

1. Wash the screens and dry thoroughly.

2. Replace the cotton with a fresh pad which, when clean, dry, and not pressed down, should be about 1/2-inch thick, carefully cut to the size of the screens. Replace the staples or re-staple.

(*c*) REASSEMBLY.

1. Insert the center orifice stud. Replace the small retaining ring. Insert the screen and stud assembly in the housing. Turn the stud to bring the two screw holes in alignment and insert the screws through the housing face. Insert the retaining ring.

2. Reassemble to the turn and bank indicator.

(2) BLEED HOLE FILTER. (*See figure* 117.)

(*a*) DISASSEMBLY.

1. Pull the cap off with pliers. The cap is pressed on the housing and is not threaded.

2. Remove the top screen, cotton, lower screen, and orifice.

(*b*) CLEANING AND REPAIR.

1. Clean the screens and orifice and dry thoroughly.

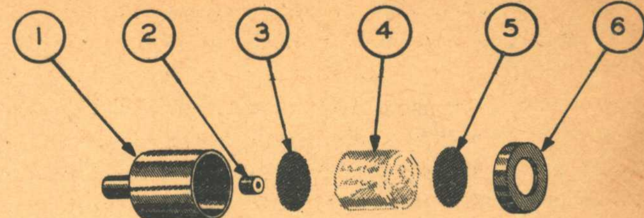


Figure 117—Bleed-Hole Filter

1. Housing
2. Orifice
3. Screen
4. Cotton Filler
5. Screen
6. Cap

2. Replace the orifice and lower screen.

3. Cut cotton pads to the size of the inside of the filter housing. Fluff up and select enough cotton to constitute a cylinder about an inch and a half long.

(*c*) REASSEMBLY.

1. Place the cotton in the housing without matting down, replace the top screen and force the cap on.

4. LIGHTS, WIRING, LINK RODS, TUBING, AND FINISH.

a. LIGHTS.

(1) FLUORESCENT LAMPS. (*See figure* 59.)

(*a*) Failure of either the bulb or starter unit will result in failure of the lamp.

Note

Bulbs for these lamps are the 4-watt size.

(*b*) To replace the starter, dismantle the lamp from the base and disconnect the wiring by removing the plug. The starter is removed by pushing it out of the base with a blunt instrument. To install the new starter unit, lift the prongs (7) up slightly to engage in the slots (9) to make contact.

(*c*) To replace defective bulbs, dismantle the lamp assembly by removing the Bakelite case from the base. Remove the bulb by pulling it out of the clip fasteners on each end, unsnapping the bottom clip first. Insert the new bulb with its flat surface flush with the metal receptacle.

CAUTION

When dismantling or reassembling the lamp, be careful not to damage the shutters or the case. The shutter is made of Bakelite and will break easily.

(2) RECORDER LIGHTS. (*See figure* 60.)—The recorder light uses two 25-volt, 2-amp single-contact bulbs. These bulbs are in series and obtain power from the 32-volt terminals marked (A) and (G) on the recorder teletorque motor. Since these bulbs are in series, one bulb will not light if the other is burned out. Any break in the circuit will shut off both lights. Replace bulbs if necessary. The recorder light assembly is held in place by a friction spring or setscrew and will slide up or down.

(3) INSTRUMENT SIDE LIGHTS. — If necessary, replace the 12–16 volt, 6 candlepower bulb in each light.

b. ELECTRICAL SYSTEM.

(1) In the event of failure of any of the electrical units, a thorough inspection should be made to insure that all connections are tight and that all plugs are in their proper places.

Note

This may save hours of unnecessary work, as transposed plugs or tip jacks may cause symptoms which appear to indicate trouble in mechanisms that should actually function correctly.

(2) Replace or repair chafed or imperfect wiring in order to avoid possible damage due to short circuits.

c. CONTROL LINKAGES AND CABLES.

(1) Rusted or corroded link rods should be cleaned and cadmium plated. If plating facilities are not available, new linkages should be installed.

(2) All linkage ball joints should be checked for undue wear. Worn joints should be replaced and all joints cleaned and lubricated with heavy oil, S.A.E. 30, Federal Specification No. VV-0-496.

(3) Replace frayed or corroded control cables.

d. TUBING AND HOSE.

(1) Replace all damaged copper tubing, synthetic tubing, and rubber hose.

(2) Blow out all copper tubing before connecting it to instruments or assemblies.

e. FUSELAGE WIRING.

(1) Inspect all fuselage wiring not removed during disassembly, for any evidence of wear, frayed insulation, sharp kinks, or other evidence of defect, replacing all defective wiring.

CAUTION

Do not attempt to rewire any part of the trainer without referring to the applicable wiring diagrams.

f. FUSELAGE—REPAIR AND REPAINT.

(1) Seal the ends of all copper tubing remaining inside the fuselage, mask the seat back upholstery and any instrument panels or other painted fixtures still installed.

(2) If no alterations or repairs are required, the fuselage is ready for sanding and varnishing. Varnish, Specification No. TT-V-121a, should be used for this work.

(3) Repaint all surfaces where necessary.

(4) Replace worn or damaged seat upholstery.

g. OCTAGON AND BASE—REPAIR AND REPAINT.

(1) Make structural repairs to wood or metal parts as required, except in such cases as a broken or cracked iron cross or main universal joint. These parts should not be repaired, but new parts should be installed.

(2) The base, octagon, spindle, and other parts so painted, should be repainted with black enamel. DO NOT USE LACQUER.

(3) The base panels, turning motor, hood, cockpit instrument panel, telegon oscillator case, base junction box case, and all other trainer parts with a crackle finish should be repainted to their original finish.

h. DESK—REPAIR AND REPAINT. — Make structural repairs as required. Mask the linoleum top and refinish in standard Army green enamel.

i. HOOD, WINGS, AILERON, AND TAIL SURFACES.

(1) Make all necessary structural repairs.

(2) Recover parts with new fabric or plywood where necessary and refinish in original colors.

5. REASSEMBLY OF TRAINER.

a. GENERAL.

(1) Reassemble the trainer base, octagon, and fuselage in the following sequence:

(*a*) Base

(*b*) Revolving octagon

(*c*) Mounting octagon on base

(*d*) Mounting fuselage on octagon

(*e*) Reassembly of fuselage

b. BASE.

(1) SPINDLE AND COLLECTOR RINGS.

(*a*) Attach the main spindle housing to the base cross with four capscrews, using lock washers under the capscrew heads.

(*b*) Check the spindle housing with a level, making sure the spindle is absolutely vertical with the base level.

CAUTION

Care should be taken, in reassembly of the spindle to the base, not to damage the collector rings when putting the assembly down on the base cross.

(2) SIMULATED GYRO TAKE-OFF. (*See figure* 80.)

(*a*) Install the take-off assembly down over the main spindle.

1. Align and adjust the gears properly.

Note

On trainers, Link Serial Nos. 7582, 7584, 7587, and thereafter, the take-off arm is to be mounted on the shaft as shown in figure 80.

2. Rotate the spindle so that the wires and the 33-wire terminal protruding from the top of the hollow shaft, and bent over at a right angle to it, are centered towards the left side of the trainer.

3. Place the take-off arm so that it is at an angle of 90 degrees from the wires and lined up with take-off gear towards the front of the trainer.

(*b*) Tighten the setscrews holding the take-off arm to the spindle.

(*c*) Install the operating arm. Turn the shaft through 360 degrees checking the gears for binding or excess backlash. Loosen the locking nut on the outside of the take-off arm below the operating arm and turn the adjusting screw until the correct mesh is obtained. Tighten the nut. Allow the operating arm to rest on the top of the base.

(3) TELEGON OSCILLATOR.

(*a*) Install the telegon oscillator case to the base with wood screws.

(*b*) Slide the oscillator unit into the case.

(*c*) Install the metal screws holding the cover and the telegon oscillator unit to the bottom of the case.

(4) BASE TERMINAL BOX.

(*a*) Install the base terminal box to the under side of the top of the base frame.

(*b*) Set the four spacers on the top of the box.

(*c*) Push the box up so that the bolts in the top of the base frame come through the spacers and the box. Install four nuts to the bolts inside of the box.

(5) COLLECTOR RING BRUSH BRACKET.

(*a*) Install the bracket holding the collector ring brushes to the bearing housing.

(*b*) Install the cable clip holding the cable to the base cross.

(*c*) Connect the telegon oscillator to the base terminal box.

(6) VACUUM TURBINE.

(*a*) Install the vacuum turbine in its original location. On some installations the turbine is located outside the base.

(*b*) Connect the turbine to the transfer elbow.

(*c*) Secure the turbine with the four mounting bolts, placing washers under the turbine if necessary to align the turbine with the transfer elbow.

(*d*) Install the cable running from the terminal on the turbine motor filter box to the base terminal box.

(*e*) Install the two cable clamps with wood screws.

(7) RADIO COMPASS TRANSMITTER TELETORQUE.

(*a*) Attach the radio compass bracket with two mounting bolts to the bearing housing.

(*b*) Connect the wiring to the terminal strip.

(*c*) Align the drive gear on the teletorque transmitter with the drive gear on the spindle assembly.

(8) WIND DRIFT MECHANISM.

(*a*) Install the wind drift mechanism in the base, securing it with its three mounting screws.

(*b*) Hook up the coil spring and mesh the small gear to the drive gear at the bottom of the spindle assembly. Align the roller with the smooth shoulder on the under side of the spindle drive gear.

(*c*) Adjust the eccentric roller mounting so as to obtain smooth operation without binding or backlash.

(9) BASE SHEAVE.

(*a*) Install the base sheave to the base cross with its four mounting bolts.

c. MOUNTING OCTAGON ON BASE.

(1) GENERAL.—Lift the octagon assembly to a sufficient height to clear the wiring protruding from the hollow shaft. Lower the octagon over the wiring to its proper position on the hollow shaft. Insert and tighten the two large setscrews securing the octagon to the main spindle housing.

(2) TAKE-OFF OPERATING ARM.—Install the operating arm guide plate over the simulated gyro operating arm and attach the plate to the forward side of the octagon with two wood screws.

(3) BELT TIGHTENER.—Install the belt tightener on the turning motor supports.

(4) TURNING MOTOR BRACKETS.—Secure the turning motor brackets to the turning motor angle iron supports with two machine screws in each arm.

(5) TURNING MOTOR.—Install the turning motor to the turning motor brackets with four mounting bolts.

(6) TURNING MOTOR BELT.

(*a*) Place the turning motor belt in the groove on the base sheave and connect the ends.

(*b*) Place the belt on the edge of the turning motor pulley.

(*c*) Hold the belt tightly and turn the trainer slightly to the right or left and the belt will take its place on the turning motor pulley.

(*d*) Place the belt between the idler pulleys on the belt tightener.

e) Adjust the idler pulleys to secure enough tension so that when the trainer is turned about by hand there is no lost motion.

(7) TURNING MOTOR HOOD.

(*a*) Install the turning motor hood over the turning motor.

(*b*) Tighten the hood with the two thumb screws located on the turning motor supports.

(8) SIDE LOCK ARMS.

(*a*) Install the two wing butt washers to the outside of the octagon with two wood screws in each washer.

(*b*) Place the bolt through the tension spring and side lock strap.

(*c*) Install the bolt through the wing butt washer.

(*d*) Place a large washer, a lock washer, and a nut on the end of the bolt, and tighten the bolt to the required tension.

(9) UNIVERSAL JOINT.

(*a*) Install the universal joint down over the wiring and secure it to the octagon cross by its four mounting screws.

(*b*) Place the leather boot down over the spindle wiring inside the universal joint.

d. REVOLVING OCTAGON—DETAILED REASSEMBLY.

(1) Place the main bellows inside the revolving octagon in their respective positions on the octagon cross.

(2) Align each bellows with the large hole in the base by turning the revolving octagon.

(3) Secure the bellows in place with four wood screws in the bottom of each bellows by reaching up through the hole in the base.

(4) Install the main hose on the main bellows elbows.

e. FUSELAGE—DETAILED REASSEMBLY.

(1) SIDE STOPS.—Install the fuselage side stops to the octagonal base of the fuselage with two machine screws in each arm, one outside and one inside, placing a washer and a nut on each screw.

(2) MOUNTING FUSELAGE TO BASE.

(*a*) Lift the fuselage sufficiently high to clear the spindle wiring and then lower the fuselage to the universal joint.

(*b*) Install the right and left machine screws used to secure the fuselage to the universal joint.

Note

The front and rear screws go through the baffle plate and cantilever brace, respectively, and then through the fuselage floor into the universal joint.

(3) CANTILEVER BRACE. — Install the cantilever brace to the fuselage floor with five mounting bolts. (See figure 72.) All but the center bolt should have lock washers under the nuts.

(4) BAFFLE PLATE. (*See figure* 72.)

(*a*) Install the baffle plate to the fuselage floor with three mounting bolts. The two end bolts should have lock washers under the nuts.

(*b*) Install mounting bolts through both sides of the fuselage to the baffle plate.

(5) FUSELAGE INTERCONNECTOR BOX. (*See figure* 72.)—Install the fuselage interconnector box between the cantilever brace and the baffle plate by sliding the flange under the floor plate and securing it with two screws.

(6) VIBRATOR MOTORS. — Replace the three vibrator motors with brackets attached, as units. One vibrator motor is attached to the back of the pilot's instrument panel, one on the remote instrument transmitter panel (figure 69), and one to the back of the panel in the remote instrument box on the operator's desk. (See figure 71.)

(7) VENTILATING FAN.

(*a*) Mount the ventilating fan in the nose of the fuselage, securing it with the mounting screws through the outside fan ring.

(*b*) Secure the electric cable to the inside fuselage wall with insulated staples.

(8) TUBING.—Install all copper tubing in the trainer.

(9) ALTITUDE TANK (CLIMB-DIVE TANK).

(*a*) Place the altitude tank above the blocks attached to the forward wall of the fuselage.

(*b*) Hold the tank near the top of the fuselage and place the yoke over the flange of the tank.

(*c*) Secure the yoke to the fuselage by two wood screws.

(*d*) Install the canvas tank apron to the fuselage under the tank.

(e) Connect the tubing to the altitude tank.

(10) AIR-SPEED DAMPING TANK.

(*a*) Install the air-speed damping tank to the rear of the fuselage by four mounting screws.

(*b*) Connect the two copper tubes leading to the air-speed damping tank.

(11) RUDDER PEDALS.—The two sets of rudder pedals, tension springs, and eyebolts are reassembled as units.

(*a*) Install the rudder pedal brackets to the floor of the fuselage with 16 machine screws, washers, and nuts.

(*b*) Install the eyebolts through the front cross member, with washers both inside and outside and nuts outside.

(*c*) Connect the tension springs from the eyebolts to the pedals.

(12) FUSELAGE CONTROL BOX.

(*a*) Install the fuselage control box with four mounting screws to the outer wall of the fuselage.

(*b*) Install the cables and connect the wiring to the terminal in the fuselage control box.

(*c*) Install the control box cover and connect the plug to the bottom of the control box.

(*d*) Clamp the tubing and wires to the fuselage floor and wall.

(13) SPOTLIGHTS AND FLUORESCENT LAMPS.—Install the two spotlights and the two fluorescent lamps with their mounting brackets to the sides of the fuselage.

(14) REMOTE INSTRUMENT CABLE.—Install the cable leading from the fuselage floor to the remote instrument panel, using four clamps.

(15) ROUGH AIR GENERATOR.

(*a*) Install the rough air generator and its motor to the fuselage floor, using two mounting screws for each unit.

(*b*) Mesh the gears on the rough air motor and the rough air generator.

(16) BELLOWS.

(*a*) AIR-SPEED REGULATOR BELLOWS.

1. Install the brackets on the bellows with six wood screws.

2. Install the bellows and brackets as one unit to the wall of the fuselage with six wood screws.

(*b*) MANIFOLD PRESSURE INDICATOR REGULATOR BELLOWS.

1. Install the brackets on the bellows with six wood screws.

2. Install the bellows and brackets as one unit to the wall of the fuselage with six wood screws.

(*c*) TURN INDICATOR BELLOWS.

1. Install the brackets on the bellows with four wood screws.

2. Install the bellows and brackets as one unit to the wall of the fuselage with six wood screws.

(17) MANIFOLD PRESSURE INDICATOR AND AIR-SPEED INDICATOR PEDESTAL BRACKETS. (*See figure* 72.)

(*a*) Install each pedestal bracket to the fuselage floor with four wood screws.

Note

Linkages running from the air-speed and manifold pressure indicator reversing arms and walking beam arm should be installed as one unit.

(*b*) Connect the air-speed and manifold pressure indicator wires through clamp nuts on the reversing arms attached to the pedestals.

(*c*) Connect these wires to their respective bellows.

(18) PITCH ACTION BRACKETS. (*See figure* 72.)

(*a*) Install the pitch action bracket located near the center of the trainer, using three mounting screws.

(*b*) Install the throttle sheathing bracket to the floor of the fuselage with four mounting screws.

(*c*) Connect the walking beam on the arm of the pitch action shaft with a split key.

Note

Make sure the linkages are not binding.

(19) STALL VALVE PEDESTAL BRACKET. (*See figure* 72.)

(*a*) Install the bracket to the floor of the fuselage in the rear of the stall valve with its two mounting screws.

(*b*) Connect the link rod running from the bracket to the pitch action shaft.

(20) PITCH ACTION COMPENSATOR. (*See figure* 72.)

(*a*) Connect the ball joint at the base of the compensator to the stud in the octagon cross.

(*b*) Connect the ball joint at the arm on the pitch action shaft.

(21) THROTTLE ASSEMBLY. (*See figure* 76.)

(*a*) Install the throttle mounting quadrant to the fuselage with two wood screws.

(*b*) Install the adjustable link rod (2, figure 72) in the ball joint at the walking beam, connecting it to the intermediate lever (7).

(*c*) Install the cotter pin and washer on the pivot block.

(22) MAIN VALVE PEDESTAL BRACKETS.

(*a*) Install the rudder valve socket to the floor of the fuselage with two wood screws.

(*b*) Install the elevator valve pedestal bracket to the floor of the fuselage with four wood screws.

(*c*) Install the aileron valve pedestal bracket to the wall of the fuselage with four wood screws.

(23) MAIN BELLOWS LINKAGE. — Remove the four half round ball nuts and two lock nuts from the bellows hook-up studs, leaving two lock nuts below the spacer and a large washer above the spacer on the stud. Pull the studs up through their respective sockets and install the half round ball nuts and two lock nuts on each stud. Allow

1/4-inch up-and-down play in the bellows hook-up studs.

(24) SLIP-STREAM SIMULATORS.

(*a*) Install the elevator slip-stream simulator to the fuselage floor with two mounting bolts.

(*b*) Install the reinforcing angle iron underneath the floor of the fuselage with the two simulator mounting bolts through the two forward holes in the angle iron.

(*c*) Install the rudder slip-stream simulator to the fuselage floor with two mounting bolts passing through the metal strap beneath the floor.

Note

The rudder simulator has a crooked lever arm.

(25) BANK TURNER LINK ROD AND BANK TURNER. (*See figure* 72.)

(*a*) Connect the ball joint on the link rod (18) to the stud in the right-hand arm of the octagon cross.

(*b*) Install the bank turner assembly (10) by four wood mounting screws, between the cantilever brace and the baffle plate on the right side of the trainer.

(*c*) Connect the link rod to the horizontal arm on the bank turner assembly.

(26) VALVES. (*See figure* 72.)

(*a*) RUDDER VALVE.

1. Install the rudder valve spindle down through its floor socket.

2. Tighten the setscrew in the socket.

3. Connect the electric leads to the compass deflector contacts.

4. Connect the main hose to the rudder valve elbows.

(*b*) ELEVATOR VALVE.

1. Install the elevator valve spindle down through the socket in the elevator valve bracket.

2. Tighten the setscrew in the socket.

3. Connect the main hose to the elevator valve elbows.

(*c*) AILERON VALVE.

1. Install the aileron valve spindle into the socket in the aileron valve bracket.

2. Tighten the setscrew in the socket.

3. Connect the main hose to the aileron valve elbows.

(*d*) SPIN VALVE.

1. Install the spin valve with four mounting screws through the spin valve base to the fuselage floor.

2. Connect the three copper tubing lines to fittings on the spin valve with three lengths of flexible tubing. (One line carries the main vacuum supply and the other two connect with the upper and lower spin bellows.) (See figure 24.)

(*e*) STALL VALVE.

1. Mount the stall valve to the fuselage floor with four mounting screws.

2. Connect the copper tube line from the climb-dive valve to the stall valve fitting with a threaded coupling; the other three copper tube lines, with flexible connections to copper tube lines on the stall valve as indicated by tags attached at the time of disassembly.

3. Connect the stall valve spring to the stall valve reversing arm.

(*f*) CLIMB-DIVE VALVE.

1. Place three wood screws in the holes in the climb-dive valve base and position the climb-dive valve on the fuselage floor behind the left end of the baffle plate.

2. Connect the operating arm to the walking beam arm on the pitch action assembly by a cotter key.

3. Install the washer and cotter key to the operating assembly.

4. Connect the copper tubing from the fixture at the limit valve end of the climb-dive valve, as marked during disassembly, and attach the flexible connection to the elbow fixture in the top of the climb valve.

(27) SHUT-OFF VALVES FOR DIRECTIONAL GYRO AND TURN AND BANK INDICATOR. (*See figure* 72.)

(*a*) Install the valves to the fuselage floor with two wood screws.

(*b*) Install the valve operating arms through the fuselage wall to the operating arms on the valves, securing them with spring clips.

(28) TRANSMITTER PANEL.

(*a*) Connect the colored leads to the rear of the panel.

(*b*) Mount the panel on the fuselage with six wood screws and rubber grommets.

(29) INSTRUMENT PANEL.

(*a*) Install the instrument panel in the fuselage with machine screws at the top of the panel and wood screws along each wall of the panel.

(*b*) Connect all colored leads to the rear of the instrument panel.

(30) CONDUCTOR ELBOW AND THROTTLE SHEATHING.

(*a*) Install the throttle sheathing connected to the conductor elbow as a unit. (See figure 72.)

(*b*) Allow the throttle sheathing to go down through the spindle wiring and transfer elbow at the base of the spindle assembly.

(*c*) Connect the throttle bushing assembly to the transfer elbow.

(*d*) Tighten the clamp holding the conductor elbow hose to the top of the spindle assembly.

(31) TORQUE SHAFT.

(*a*) Place the torque shaft in front of the baffle plate.

(*b*) Move the torque shaft back through the torque shaft pedestal bracket in the rear of the fuselage.

(32) WHEEL BASE. (*See figure* 73.)

(*a*) Install the wheel base on the floor of the fuselage in front of the baffle plate with four mounting bolts, two bolts passing through the rear holes in the reinforcing angle iron underneath the fuselage.

(*b*) Connect the ball joint at the elevator operating arm.

(*c*) Slide the torque shaft forward and connect it to the wheel base.

(*d*) Tighten the two setscrews holding the torque shaft.

(33) WHEEL COLUMN. (*See figure* 74.)

(*a*) Tilt the top part of the control column to the rear and install the aileron link over the link pin. (See figure 73.)

(*b*) Install the two capscrews holding the base of the wheel column to the control column base.

(34) CONTROL COLUMN—STICK TYPE. —Install the stick in the top of the control base.

(35) AIR MANIFOLD.

(*a*) Connect the air manifold to the top of the rudder valve.

(*b*) Connect the conductor elbow, elevator, and aileron valve with their hose connections.

Note

At this point connect all copper tubing, running to various units, with flexible tubing. All tubing and connections were tagged for proper identification during the disassembly procedure.

(36) RUDDER BAR ASSEMBLY. (*See figure* 72.)

(*a*) Connect the rudder bar at its pivot point on the fuselage cantilever brace.

(*b*) Install the rudder pedal cables at both ends of the rudder bar.

(*c*) Connect each rudder bar cable to the pins on the rudder pedals.

(*d*) Connect the ball joint on the rod to the rudder slip-stream simulator and the rudder bar.

(*e*) Connect the operating arm and rod from the rudder bar to the bank turner walking beam.

(37) REMOTE CONTROL TRANSMITTER INSTRUMENTS. (*See figure* 69.)

(*a*) Connect the copper tubing lines running to each instrument on the remote control transmitter panel.

(*b*) Install the telegon transmitter instruments to the panel, using three mounting bolts in each instrument.

(*c*) Connect the electric leads running to each instrument.

(38) INSTRUMENTS ON PILOT'S PANEL. —Working from the front of the main instrument panel, replace the instruments, each with four Phillips head machine screws, in the following order:

(*a*) Vertical-speed indicator

(*b*) Turn and bank indicator

(*c*) Air-speed indicator

(*d*) Manifold pressure indicator or tachometer, whichever is standard equipment

(*e*) Artificial horizon

(*f*) Directional gyro

(*g*) Altimeter

(*h*) Magnetic compass

(*i*) Army cross pointer, Navy cross pointer, or flight path indicator

(*j*) Automatic radio compass

(*k*) Clock

(39) SIMULATED DIRECTIONAL GYRO. (*See figure* 80.)

(*a*) Pass the simulated gyro flexible cable down through the hole in the fuselage floor and through the hole in the octagon cross to the take-off assembly.

(*b*) Clamp the cable to the control wheel base and to the floor support. Connect the cable to the gyro in the rear of the instrument panel.

(40) DOOR.

(*a*) Install the cockpit door by mounting two bolts through the hinges.

(*b*) Connect the electric leads running to each door hinge.

(*c*) Connect the electric leads to the moonbeam spotlight from the hinge mounting bolts.

(41) HOOD.

(*a*) Replace the hardware on the hood.

(*b*) Reassemble the hood stop.

(*c*) Reassemble the lock to the hood with four wood screws.

(*d*) Install all handles, brackets, peephole casings, ventilator shields, and other exterior fittings if hood has been painted.

(*e*) Install the hood indicator box assembly with four machine screws.

(*f*) Place the hood in the hood hinges and insert the cotter pin in the rear hinge.

(*g*) Connect the cable running from the indicator box to the fuselage junction box.

(42) ELEVATOR BRACKETS.

(*a*) Install the elevator brackets at the rear of the fuselage with two wood screws.

(*b*) Install the elevators and stabilizers as one unit.

(*c*) Install two machine screws through the stabilizers and elevators to the bracket attached to the fuselage.

(*d*) Attach the two stabilizer supports to each side of the fuselage with one wood screw in each end of each support.

(43) RUDDER BRACKETS.—Install four wood screws through the rudder brackets attaching them to the fuselage.

Note

On trainers manufactured prior to Link Serial No. 5019, install the link rod running from the movable rudder to the rudder bar assembly, and install the elevator link rods to the walking beam assembly connected to the elevator valve.

(44) PITOT HEATER SIGNAL LAMP. (*See figure* 77.)

(*a*) Reassemble the socket halves, connect the electric leads, and assemble to the bracket.

(*b*) Mount the bracket to the bottom edge of the fuselage.

(45) FLOOR MATS.—Attach the rubber floor mats to the fuselage floor with tacks.

(46) WINGS.

(*a*) Install two machine screws at each end of the support rods holding the wings to the fuselage.

(*b*) Install the rods running from the fuselage to the wings.

f. OPERATOR'S DESK.

(1) DESK JUNCTION BOX.

(*a*) Mount the desk junction box under the desk, attached to the back by four screws.

(*b*) Connect the 33-contact plug to the base junction box.

(*c*) Pull the cable for the automatic recorder down through the conduit over the desk for convenience in attaching it to the recorder.

(2) RADIO.

(*a*) Place the radio chassis in the center drawer of the desk.

(b) Connect the plug at the back of the chassis.

(3) REMOTE INSTRUMENT BOX.

(a) Remount the four instruments on the remote instrument box panel.

(b) Install the vibrator motor and bracket as a unit on the back of the instrument panel.

(c) Attach the panel to the box with six screws through the front of the panel.

(d) Replace the back panel and connect the two plugs on the cables from the desk junction box.

(4) AUTOMATIC RADIO COMPASS CONTROL UNIT.

(a) Replace the instrument and the panel through the front of the cabinet, securing it with four screws.

(b) Attach the ears on the plug to the bracket in the base of the cabinet with two screws.

(c) Replace the back panel and connect the plug on the cable from the desk junction box.

(5) WIND DRIFT CONTROL UNIT.

(a) Install the unit on the right-hand end of the desk, securing it with five machine screws.

(b) Connect the two flexible shafts to the wind drift control unit on the desk and to the wind drift mechanism in the trainer base. (See figures 68 and 108.)

g. POWER SUPPLY.

(1) Connect the cable running from the desk to the base terminal box.

(2) Plug in the main power supply cable.

(3) See that the proper power supply is being used for the trainer. Inspect all fuses for proper amperage and see that all electrical plugs and contacts are firmly seated.

(4) Turn on the line switch and the turbine switch on the base terminal box, and the ignition switch on the trainer instrument panel. If electrical units are inoperative when they are switched on, check for continuity. Check for shorts and grounds if fuses are blown out.

SECTION V
TEST PROCEDURE

1. GENERAL INSPECTION.

Before testing individual systems or mechanisms, the following preliminary inspection should be made:

a. Determine that proper power supply (cycles and volts) is being used.

b. See that all electrical plugs and contacts are firmly seated.

c. Make sure all mounting bolts, mounting screws, and setscrews are tight.

d. Inspect levers and linkages to insure that there is no excessive play and, at the same time, no binding.

e. Make sure all tubing is properly connected and that no leaks exist either in the connections or in the tubing itself.

2. KEY ADJUSTMENTS.

As many of the adjustments of the trainer mechanisms are dependent on the proper functioning of other mechanisms and assemblies, the following basic adjustments should be checked as a starting point in testing and regulating the altitude instrument control mechanisms and linkages:

a. The trainer itself should be level.

b. The pitch action compensator arm (6) on the pitch action shaft (figure 30) and link rod arm (2) on the bank turner assembly (figure 21) should be in a horizontal position when the trainer is locked level. (See paragraph 2e of this section.) These arms should be checked with a spirit level and, if not horizontal, the push-pull rods which extend downward to the iron cross in the revolving octagon should be lengthened or shortened as required.

c. The walking beam (5), which pivots on the bell crank of the bank turner assembly (figure 21), should be in a vertical position when the rudder pedals are centered.

d. The walking beam (9), which pivots on the arm of the pitch action shaft (figure 30), should be vertical when the throttle is set at cruising with both the climb-dive valves closed.

e. Many of the tests and adjustments are based on the trainer being in *absolutely* level flight. This is referred to as locked level position or cruising position.

f. To obtain the locked level cruising position, turn on the trainer, leaving the side and rear locks engaged. Move the elevator control fore and aft until the rear lock pin is *centered in the hole in the strap.* The trainer will then be floating in the rear lock strap without any contact between the lock pin and the strap. To make sure of this, remove the lock strap for a moment. The fuselage should not change position and the strap should readily slip back into place. With the trainer floating in the straps, open or close the throttle until the arms of the climb-dive valves are both against their stops.

Note

It is important that the *locked level* or *cruising position* be thoroughly understood as proper operation of many of the trainer mechanisms cannot be obtained unless the trainer is in this position at the time these mechanisms are regulated and adjusted.

3. VACUUM SUPPLY.

a. The trainer is regulated for efficient operation at 4-3/8 inches Hg.

b. To test and adjust the actual output of the turbine, proceed as described in paragraph 25 of this section.

c. A lowered vacuum supply may cause sluggishness of trainer movement and faulty indications of the vacuum operated instruments.

d. The possible causes of a lowered vacuum supply are:

(1) Leaks in bellows or vacuum lines.

(2) Kinked or disconnected hose.

(3) Low turbine output.

4. FOUR MAIN BELLOWS.

Test the action of the four main bellows. If there appears to be excessive play or too little play in the operation of any bellows, the lock nuts should be loosened on the bellows stud (on the under side of the fuselage floor) and adjusted so there is approximately 1/4-inch of up-and-down play when the bellows is fully extended.

5. SLIP-STREAM SIMULATORS.

(*See figure* 14.)

a. Test these units for smoothness of operation. There should not be excessive play and, at the same time, no binding in the link rods to the controls.

b. The degree of resistance is controlled by means of the resistance adjustment.

c. If there appears to be excessive friction or a slight jerkiness at the start of movements, the packing nut should be loosened slightly.

d. These units seldom require refilling. However, if more fluid is required, use Houde shock absorber oil, or use castor oil of approximately 500 S.U.V. at 38° C. (100° F.) The unit should be filled to the bottom of the filler hole.

6. INTERCHANGEABLE WHEEL AND STICK CONTROL.

(*See figures* 73 *and* 74.)

a. Operation of controls by both wheel and stick should be tested.

b. To change from wheel to stick remove the two capscrews at the base of the wheel column. Slide the column back slightly on the base to disengage the long control rod from the stud and remove the wheel assembly. The metal control stick may now be screwed into the socket by hand. To install the cover plate use the same capscrews used to secure the wheel column.

c. To change from stick to wheel, simply reverse the procedure. However, be sure the long control rod and stud are engaged before tightening the capscrews.

d. If a light "feel" is desired on the aileron control when the stick is being used, the lighter pair of aileron control loading springs, provided in the tool kit, should be installed. (See 4, figure 74.)

Note

These lighter springs are not heavy enough for normal "feel" with wheel

Therefore, if the wheel control is installed, the heavier springs should be used.

e. To test and install the lighter aileron control loading springs, provided in each kit, proceed as follows:

(1) Move the stick to the extreme right and brace or otherwise prevent it from moving back toward the center. This will remove the spring pressure applied to the left spring roller stud.

(2) Unscrew the spring roller stud, using a 1/2-inch open end wrench, and lift the spring and cap assembly off the guide stud underneath the spring.

(3) Place the stick in the full left position and brace or hold it from returning toward center while the right-hand spring is similarly removed.

(4) Slide the new spring and old spring cap assembly down over the guide studs. Reinstall spring rollers, reversing the disassembly procedure.

Note

It may be necessary to compress each spring slightly in order to start the roller stud in the threads. This can be accomplished by pushing down on top of the spring cap by hand.

(5) In most cases the valve in the slip-stream simulator should be in its fully open position to further lessen the load on the stick.

7. TURNING MOTOR.

(*See figure* 106.)

a. TESTING VALVE TIMING.—Each valve should start to open and the bellows fabric start to move just as the connecting rod passes dead center. Adjusting the timing of the opening of the slide valves is done with the two leather or composition nuts which position the slide valve yoke on the valve rod.

b. If for any reason the timing adjustment should be disturbed or if the leather nuts become loose, an approximately correct timing may be obtained by adjusting the leather nuts so that the top of the slide valve is flush with the bottom of the outer hole on the face of the valve.

c. If the banks are removed from the turning motor base, the timing adjustment between the two banks will be disturbed unless scriber marks are placed on the small gears and on the large gear so that, when reassembling, the gears can be meshed exactly in their original position.

d. If for any reason the banks have been removed without marking the gears, it will be necessary to readjust the timing. This is accomplished by having the throws of the crankshafts 180 degrees apart and testing the turning motor for smooth operation.

e. Oscillation of the turn indicator during a one-half standard rate turn is an indication of faulty timing. The timing should be advanced on one or the other of the banks, by trial and error method, until oscillation of the turn indicator is minimized.

f. TESTING FOR WEAR.—If wear occurs in the connecting rods, remove the screw and thin washer. Washers of the proper thickness can be made of standard brass shim stock.

CAUTION

Make sure there is absolutely no bind in the movement of the connecting rods, as even a slight amount will cause uneven running of the motor. It is better to have the rods too loose than too tight. If squeaking occurs on the bearing of these rods, a single drop of oil, Specification No. AN-0-6, may be applied.

g. TESTING SPRINGS.—If one of the valve link rod springs should become overstretched, it cannot be adjusted and must be replaced with a new spring. In replacing these springs care should be exercised so they will not be stretched too far.

8. BELT TIGHTENER.

(*See figure* 11.)

a. The belt tightener provides a means of adjustment so that the turning belt may at all times be kept at the correct tension.

b. The adjustment consists of loosening the hex nuts on top of each idler pulley and moving the pulleys in or out from the center on the two supporting bars until the belt is under correct tension.

c. The belt should be tight enough so there is no lost motion between the movement of the rudder and movement of the trainer and loose enough so that some slip or coast occurs when opposite rudder is applied to change a turn from one direction to the other. The amount of coast should be approximately 45 degrees when applying full opposite rudder from a full rudder turn, with trainer locked in the straps.

9. ROUGH AIR GENERATOR.
(*See figure 22.*)

a. In testing for correct operation of this unit, the flap valves should open 3/16 of an inch. The two right-hand flap valves should remain open and the other four should be closed when the rough air is cranked off.

b. Adjustment of the two right-hand flaps is made by loosening the two screws in the metal plate on the base of the unit, midway between the crank and the right-hand edge, and moving the plate until flaps are open 3/16 of an inch.

c. Adjustment of the remaining flaps is made by changing the position of the adjustable locking nuts on the crank.

10. TESTING AND ADJUSTING MAIN VALVES.

a. RUDDER VALVE.

(1) Clamp the rudder pedals in a centered position and turn on the trainer. With the trainer locked in both side and rear straps, turn on the rough air. Set the directional gyro to zero and uncage. If the trainer does not yaw an equal amount in both directions, the rudder valve is off center.

(2) The rudder valve is located under the right rear corner of the seat and the socket extends down through the fuselage floor. This socket and the setscrew are reached from outside the trainer, under the cloth skirt.

(3) Be sure the spin trip assembly is in normal flight position. Then, loosen the rudder valve setscrew and rotate the bottom half of the rudder valve one way or the other until the trainer yaws an equal amount in both directions. Tighten the setscrew and recheck to make sure the yaw is equal and the rudder pedals are centered.

b. AILERON VALVE.

(1) To test the adjustment of the center leaf of the aileron valve, first make sure the spin trip assembly is in its normal operating position and that the rudder pedals are centered. Leave the trainer line switch turned off.

(2) The two large elbows which extend out of the bottom of the aileron valve should be on a line level with the fuselage floor. Lock the base (fixed portion) of t
the setscrew

(3) The
be so adjuste
the trainer

(4) To g
justment must
24) attached to the
the bell crank (17) on
adjustment cannot be obta... rod, a
ditional adjustment may be obtained from the ball joint on rod (9) leading from the bell crank (17) to the rudder bar.

(5) Next, turn on the trainer, leaving the side and rear locks engaged. Make sure the spin trip mechanism has returned to its normal position and the rudder pedals are centered. Then, loosen the lock screw in the lever arm (R, figure 24) located on the rear end of the torque shaft, which connects by means of a short link rod (T) to the front half of the aileron valve (19, figure 24).

(6) Put the stick or wheel in its neutral position. Then, with the trainer still running, adjust the position of the aileron valve lever arm (R, figure 24) and with it the movable part of the valve, to a position where the trainer is floating in the side locking strap. When this condition is obtained, tighten the setscrew in the aileron valve lever arm.

(7) Recheck the control column and rudder pedals to make sure they are still centered.

Note

In centering the valves, the rudder valve and the center leaf of the aileron valve must be centered first.

c. ELEVATOR VALVE.

(1) Due to the variable spring loading unit, it is necessary to insure that the wheel or stick is in a vertical position before attempting to test the elevator valve for proper adjustment. Should it be necessary to change the position of the wheel or stick forward or backward to obtain the vertical position, this is accomplished by adjusting the bottom spring lock nut; increasing the bottom spring tension to move the wheel or stick forward, or decreasing the spring tension to move it backward.

(2) Tighten the lock nut and proceed to adjust the lower half of the elevator valve so the trainer will remain level and float in the rear lockir

...he climb-dive ...gure 28), stall ...nd vertical- ... connecting ... system—un- ... possible to ob- ...rainer. Therefore, ...ttempted, the follow- ...rformed:

(1) Climb the trainer up to 1000 feet altitude; then, with the trainer in the locked level position, set the throttle at cruising position making sure the climb-dive valves (figure 28) are closed (arms against the stops). Tie or wire the stall valve pendulum (figure 89) in the closed position (pendulum towards the front).

(2) Next switch off the turbine. In order to get sensitive altimeter indications the line switch and ignition switch should be left on so that the vibrators will be operating.

(3) If no leaks are present in the altitude system, the altimeter should not lose over 100 feet in 5 minutes.

(4) If the altimeter indicates a loss of more than 100 feet in 5 minutes, all tubing and connections should be checked to determine the source of the leak. If the leak is still present after all tubing and connections have been checked, the climb-dive valves should be tested and adjusted in accordance with instructions contained in Section IV, paragraph 3*b*(5)(*d*)4.

12. THROTTLE TESTS—VERTICAL-SPEED ADJUSTMENT.

Note

Before attempting to regulate or adjust any of the instruments or mechanisms in the altitude system, the altimeter should be set to indicate approximately 500 feet below zero.

a. With the trainer running and floating in the lock straps, with the stall valve pendulum tied or clamped in the forward position, open the throttle fully.

b. When the altimeter indicates 1000 feet of altitude, the vertical-speed indicator should show approximately 600 feet per minute ascent.

c. If the vertical-speed indicator does not show 600 feet per minute ascent under the above conditions, lengthen or shorten the link rod connected to the bottom of the throttle by adjusting the turnbuckle, until 600 feet per minute ascent is shown on the vertical-speed indicator.

Note

On trainers previous to Link Serial No. 5960 this adjustment was made by disconnecting this link rod at either or both ends, loosening the ball joints and nuts, and lengthing or shortening the rod, as required.

d. If sufficient adjustment cannot be obtained on the link rod, additional adjustment can be obtained by lengthening or shortening the long control rod connecting the lever arm and the walking beam on the pitch action shaft.

13. REGULATOR BELLOWS.

The air-speed and manifold pressure regulator bellows were tested for leakage when refabricated. They are equipped with self seating valves and, except for cleaning, require no further test or adjustment.

14. ADJUSTING LIMIT VALVES FOR MAXIMUM CLIMB AND DESCENT.

a. If the maximum climb were permitted to become too great, the needle valve in the stall valve assembly would not be capable of letting air into the system fast enough to show the proper mush during stalls. A plain shut-off type valve is provided at the ends of both the climb and the dive valve to restrict the flow of air to the desired rate of climb and descent as shown in the calibration specifications chart (figure 118).

b. With the altimeter indicating 1000 feet of altitude, the stall valve pendulum clamped in the forward position, and the throttle wide open, nose the trainer up until maximum climbing speed is reached. If the vertical-speed indicator does not show ascent of approximately 1300 feet per minute, proceed as follows:

(1) Using a screw driver, shut off the limit valve located at the end of the climb valve (figure 28). Unlock the trainer and with the throttle wide open, nose the trainer up until maximum climbing

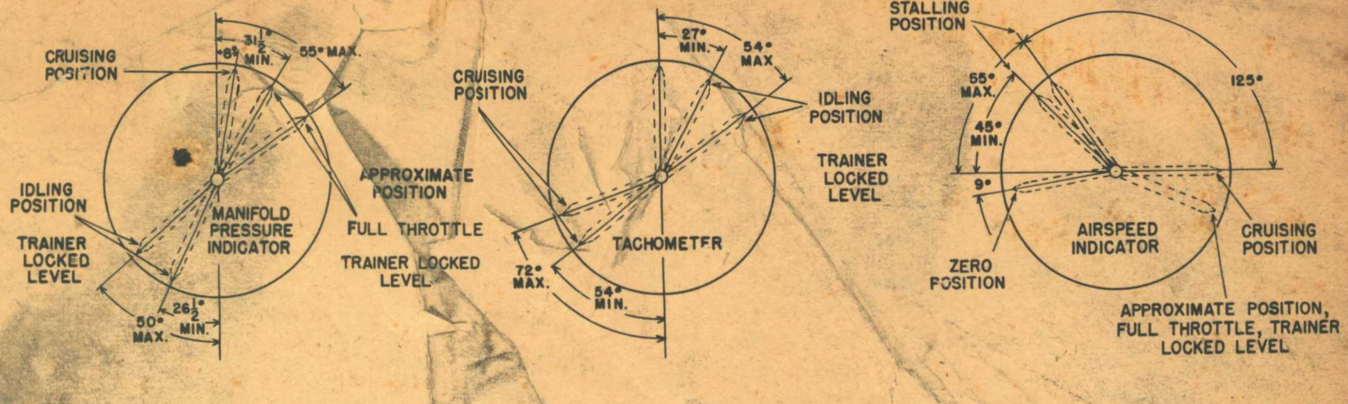


Figure 118—Calibration Specifications

VERTICAL SPEED:

Locked level, full throttle—approximately 600 feet per minute.

Nose up, full throttle (pointer of air-speed indicator in vertical position)—maximum climb approximately 1300 feet per minute.

At gliding speed (¾ of cruising speed), throttle closed, minimum rate of descent—500 feet per minute.

Note

The above performance specifications are based on readings when pointer on altimeter is passing the 1000-foot indication (altimeter zeroed at minus 500 feet).

STALLING SPEED:

May be set to stall anywhere between 65 mph and 80 mph according to preference. Stalling speed must be the same whether nosed up with throttle closed, cruising, or throttle fully open.

speed is reached (air-speed indicator hand in a vertical position). Keep the trainer in this position and open the limit valve on the climb valve (the one without the filter).

(2) Adjust the limit valve until, at an altitude of 1000 feet, a rate of climb of approximately 1300 feet per minute is shown on the vertical-speed indicator.

(3) Nose up the trainer several times to make sure that the correct setting is obtained on this limit valve.

(4) Level off the trainer at an altitude of 1000 feet and set the throttle at cruising. With the throttle set at cruising, the vertical-speed indicator should return to zero, and the altimeter reading should remain constant.

c. With the altimeter indicating 1000 feet, the throttle in the closed position, and the trainer nosed down to maximum diving position (fuselage against the stops), if the vertical-speed indicator does not indicate a rate of descent of approximately 1000 feet per minute, proceed as follows:

(1) Open the limit valve on top of the dive valve and adjust until the vertical-speed indicator shows desired rate of descent.

(2) Climb the trainer up to 1000 feet and try several maximum dives to make sure the setting of the limit valve is correct.

Note

Before indications of descent can be shown on the vertical-speed indicator, the trainer must be flown to an altitude above zero.

15. TESTING STALLING SPEED ADJUSTMENT.

a. The trainer should stall and start to spin when the pointer on the air-speed indicator is in the stalling position shown in figure 118.

b. Before attempting to adjust the stalling speed of the trainer, check the following items:

(1) See that the spring on the stall bellows is 3-1/4 inches long (not including end loops) when the bellows is fully collapsed. This measurement can be increased or decreased by means of the adjusting nut on the end of the spring.

(2) See that the pendulum lever adjusting stud (mush pin) is set at approximately 1-19/32 inches from the bottom of the hole in the pendulum arm.

c. These settings are used in order that the vertical-speed indicator will indicate the correct mush and so that the trainer will stall at the same speed with closed, cruising, or open throttle. The stalling speed should be adjusted so that the pointer on the air-speed indicator agrees with the stalling position shown in figure 118.

d. With the trainer locked level, the throttle in cruising position, slide the stall valve link stop (pickup pin) on the stall valve link bar until it is almost touching the mush pin. Unlock the trainer and nose it up, allowing the air speed to decrease slowly, until the inverted pendulum falls over against the atmosphere vent in the jet assembly. At this moment, the position of the air-speed indicator hand should be noted. If the position of this hand does not correspond to the stalling position shown in figure 118, and is too low at the moment the trainer stalls, move the pickup pin slightly toward the rear of the trainer and test again. Repeat until the trainer stalls at the desired speed.

e. Next, adjust the stall valve recovery pin so that it just clears the mush pin on the pendulum arm at the exact moment the pendulum arm strikes the rear stop. (This setting is used so that the recovery pin will not interfere with the stall.)

f. Next, stall the trainer by nosing it up at full throttle and again at closed throttle. The position of the hand on the air-speed indicator at the stalling point should be the same in both cases as it was when nosed up from cruising speed. If the stall bellows spring has not been tampered with, the stalling speed should be the same at all throttle positions. If this spring has been stretched or damaged, a new spring must be installed.

16. ADJUSTING AIR-SPEED AND MANIFOLD PRESSURE INDICATIONS.

a. With the trainer in locked level cruising position, the air-speed indicator hand should be exactly horizontal, pointed toward the right. If the reading is low, the knurled nut on the air-speed regulator bellows (figure 26) should be tightened and, if the reading is high, it should be loosened.

b. In making this adjustment, the knurled nut should be moved only a turn or two and then released from the fingers to allow the bellows to function and the air speed to settle down again.

CAUTION

Do not squeeze the regulator bellows together by hand.

c. The manifold pressure indicator is adjusted to the cruising position in the same manner as shown in figure 118.

d. Normally, this is the only adjustment required for correct air-speed and manifold pressure indications, as the tension of the regulator springs is carefully adjusted at the factory.

e. Frequent checks should be made of air-speed and engine-speed indications. With the trainer floating in the locks, close the throttle and note the air-speed and manifold pressure indications. If the pointer of the air-speed indicator drops lower than 10 mph below stalling position (figure 118) or the manifold pressure indicator falls back to less than idling position, it indicates the regulator bellows spring is too stiff.

Note

This could not occur with the spring originally supplied on the trainer, as it would not grow stronger.

f. A weak spring is indicated if the readings on the air-speed indicator and manifold pressure indicator do not fall back low enough.

g. If it is finally proven that either of the regulating springs has become too weak, a new spring must be installed, by careful stretching, to the individual trainer. To do this, proceed as follows:

(1) Put the new spring in place, leaving the adjusting nut well out toward the end of the thread. Next, turn on the trainer and adjust the elevator control until there is absolutely no pull—up or down—on the rear locking strap. This means that the lock must be floating in the hole in the strap so that the strap may be slipped off and on again without any change in the attitude of the trainer fuselage. Then open or close the throttle until the climb-dive valves are both closed (arms against the stops).

(2) The regulating spring adjusting nut should now be tightened until the indicator pointer is exactly at cruising speed (figure 118). Next, close the throttle.

(3) If the indicator falls back below the proper idling speed, the spring is too stiff and must be stretched slightly. To do this, remove the spring. Hook one end of the spring onto a nail held in a vise or driven into any convenient board. Place a machinist's scale or rule under the spring and against the nail. Stretch the spring to a length of about 4-1/2 inches. Replace the spring in the trainer

and adjust the nut until the indicator is at cruising position, just as was done before. Then, check the indications on the instrument at full throttle and again at closed throttle against the indicator pointer positions shown in figure 118. Be sure the trainer is still floating in the lock strap.

(4) If, with closed throttle, the indicator still falls back too low, the spring must be removed and stretched again. This stretch should be to approximately 4-3/4 inches. Install the spring in the trainer and adjust and test as above. This procedure must be repeated until the desired indications are obtained.

WARNING

As soon as the air-speed indicator shows any effect from stretching the spring (doesn't fall back quite so low), any further stretching must be done very carefully so as not to overstretch and ruin the spring. At this point, the increase in stretch should be only 1/16 of an inch at a time. If the spring has been stretched too much and is too weak, correct indications may be shown at closed throttle and cruising but there will not be enough increase from cruising to full throttle. Sometimes, if a spring has only been slightly overstretched, a few turns of the coils (not more than 3) can be removed to regain the proper characteristics. However, in practically all cases, if it has been overstretched, there is nothing that can be done except install a new spring and start the adjustment procedure again.

h. The air-speed indicators and the manifold pressure indicator on the trainer are so designed and calibrated as to require a certain amount of vacuum to move the pointers certain distances around the dial regardless of the numeral appearing on the face of the instrument. The linkages and regulator bellows are so engineered as to supply just that certain amount of vacuum at any throttle position and at any trainer attitude, and also at any combination of throttle position and trainer attitude.

i. In cruising position, namely, with trainer in the lock straps, the climb-dive valves closed (arms against stops), the air-speed indicator pointer should be horizontal at a position corresponding to figure 3 on a clock face, regardless of the numeral appearing under the pointer. If it is desired to simulate a different cruising speed than appears under the pointer, as mentioned above, it will be necessary to replace the dial. Figure 118 shows the proper position for the pointers at stalling speed, cruising speed, and full throttle.

17. COMPASS DEFLECTOR.

a. If a slow turn is started from a northerly heading, the compass should start to swing when the turn indicator shows one-half the deflection of a standard rate (3 degrees per second) turn.

WARNING

The turn indicator must have been running long enough to attain normal operating speed.

b. If the needle is too far out when the compass starts to swing, the contact plates on the bottom half of the rudder valve (figure 17) must be moved slightly nearer each other. Adjust the right-hand plate for left turns, and the left-hand plate for right turns. If the compass swings with too little movement of the turn indicator, the plates should be moved apart slightly. Both contact plates and the moving contact must be kept clean.

c. The amount of effect on the compass is determined by adjustment of the sliding contact on the resistor located in the fuselage control box. To check the amount of deflection, head the trainer north and turn on the main switch. Have someone hold the trainer from turning and apply enough rudder to deflect the compass. It should deflect approximately 30 degrees. When left rudder is applied, the compass should swing to a heading of about 30 degrees; when right rudder is applied, it should swing to about 330 degrees.

Note

In the southern hemisphere, the swing should be reversed. To accomplish this, simply reverse the wires leading to the two plates on the rudder valve.

18. LANDING GEAR, PROPELLER PITCH, AND FLAP CONTROL DEVICE.
(*See figure* 43.)

This device requires no adjustment unless it might be desired to have the landing gear warning buzzer and warning light operate at a different throttle position. Some adjustment can be obtained

by loosening the two setscrews in the plate on top of the micro-roller switch and changing the position of the plate in relation to the throttle linkage. The micro-roller switch is mounted on the left side of the cockpit just forward of the throttle lever. If additional adjustment is needed the bracket on which the micro-roller switch is mounted may be unscrewed from the side of the fuselage and moved to the desired position.

19. FUEL GAGE.

(*See figure* 42.)

This is a clockwork mechanism requiring no test or adjustment.

20. ICE VALVE AND DE-ICER EQUIPMENT AND SHUT-OFF VALVES FOR DIRECTIONAL GYRO AND TURN AND BANK INDICATOR.

(*See figures* 44 *and* 77.)

These units are simple shut-off valves on which no tests or adjustments are required.

21. AUTOMATIC RECORDER.

(*See figure* 113.)

a. The automatic recorder should be checked and tested periodically (or whenever a need is indicated) for alignment and proper tracking.

b. To check the alignment of the driving wheels, place a straightedge against them as shown in figure 114. Both wheels should be flat against the straightedge. If they are not, loosen the setscrews in one of the large gears which are mounted on the vertical shaft and turn the shaft until both wheels are flat against the straightedge.

c. To align the inking wheel, place the straightedge against one of the drive wheels and the inking wheel (figure 114). The straightedge should be placed against the side of the driving wheel which is away from the driving gear. Again, the two wheels should be flat against the straightedge.

d. The pointer on the azimuth scale on top of the automatic recorder must be exactly in line with the inking wheel. Place the straightedge tightly against the two driving wheels. Set the pointer so that it is either exactly on 90 degrees or 270 degrees and pointed in the direction the inking wheel travels.

e. The telechron driving motors obtain current through slip-rings just above the motors. These rings and brushes must be kept clean and the

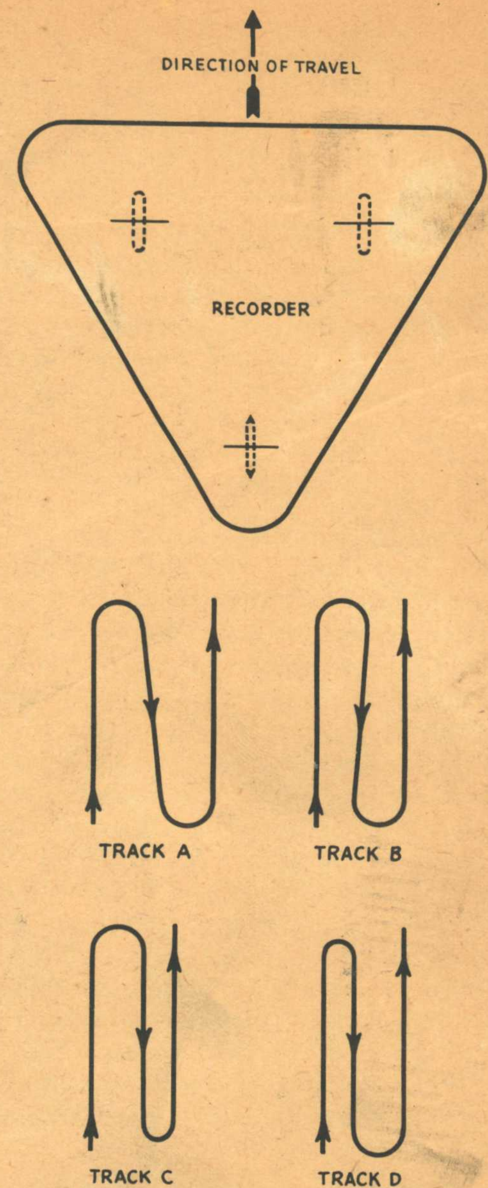


Figure 119—Automatic Recorder Test Track

brushes must maintain firm pressure against the rings.

f. If the automatic recorder is pushed hard against the desk, banked against the desk edge, or otherwise roughly handled, the driving wheels may be sprung out of line. If this occurs, the recorder will draw non-parallel lines on reciprocal headings and circles of unequal diameter in opposite directions. This is caused by displacement of the driving wheels from their proper positions. The point of contact of each driving wheel with the map or chart should be exactly under the center of its vertical spindle.

(4) A more definite check may be obtained by measuring the distance between the end of the air-speed slide bracket and the stop collar (X, figure 108). At indicated cruising air speed this distance should be adjusted to 15/16 inches by the procedure described above.

(5) As a matter of interest, 10 mph of automatic recorder movement is represented by:

5/32-in. movement of the air-speed slide
7/64-in. movement of the electric throttle cable
3/32-in. side movement of the ground-speed cam

Note

Before adjusting for correct recorder travel, make sure the air-speed system is in perfect adjustment. (See Section V, paragraph 16.)

d. DETAILED INSTRUCTIONS FOR ADJUSTING AUTOMATIC RECORDER TRAVEL.

(1) Turn on the trainer ignition switch and set the throttle at cruising. Make sure both climb-dive valves are closed and the trainer is floating in the straps. The air-speed indicator reading must be exactly at cruising for this check.

(2) Connect the cable to the automatic recorder and let it run a minute or so until the telechron motors warm up.

(3) Place the automatic recorder on a piece of white paper on the desk and, with a stop watch, note its travel in one minute. Make sure the air speed is at cruising and both the wind velocity and wind direction control dials are at zero.

(4) Before proceeding further, check whether the frequency of the main current supply is 50 or 60 cycles.

(5) The rate of automatic recorder travel at 160 mph and 120 mph for 60-cycle current and for 50-cycle current is shown in the following table:

SPECIFICATION (A)—*on 60-cycle current:*
Air speed—160 mph—Recorder travel—.800 (51/64 in. per min.)
Air speed—120 mph—Recorder travel—.600 (39/64 in. per min.)

SPECIFICATION (B)—*on 50-cycle current:*
Air speed—160 mph—Recorder travel—.667 (43/64 in. per min.)
Air speed—120 mph—Recorder travel—.500 (32/64 in. per min.)

TOLERANCES: plus or minus 1/32 in. per min.

Note

A recorder test graticule can be made for desk use by ruling four or more parallel lines on a sheet of paper, spaced in accordance with Specification (A) for 60-cycle current or (B) for 50-cycle current. Set the automatic recorder on the graticule so that the track will be at right angles to the parallel lines. Allow the recorder to run long enough to warm up the telechron motors; then, time the recorder travel across three or more lines.

(6) If the automatic recorder travel is short of the distance specified above for 160 mph air speed, increase the rate of travel by shortening the bronze cable in the fuselage. This is accomplished by partially loosening nut (C, figure 120) located on top of the air-speed lever arm. With this clamp nut only holding slightly pull the bronze cable through the swivel toward the back of the trainer approximately 1/16 of an inch and tighten the nut (C).

WARNING

Do not let go of the bronze cable unless the clamp nut is tight, as the cable will be pulled into its housing.

(7) Recheck the rate per minute of recorder travel over a period of five minutes. If the travel is greater than the specified limits of 60 mph air speed, loosen the clamp nut a little and allow the cable to slip forward through the swivel approximately 1/32 of an inch. Tighten the clamp nut and recheck the recorder travel per minute over a period of five minutes.

Note

This is the main adjustment of the wind drift mechanism and must be correct in order to obtain accurate results from the wind direction and wind velocity controls.

(8) When the recorder travel has been brought within the specified tolerances at 160 mph air speed, reduce the air speed by slowly closing the throttle. Work the throttle back and forth to remove any play or bind in the mechanism; then set it up to an indicated air speed of exactly 120 mph.

CAUTION

Be sure the trainer is still floating in the lock straps.

(9) Check the recorder travel per minute over a period of five minutes. If the rate of travel is above the specified limits, decrease it by loosening nut (D, figure 120), and moving it up on the lever arm. Tighten the clamp nut and recheck the recorder travel.

(10) If, however, the recorder travel is less than the specified distance, loosen the nut (D) and move the clamp down on the lever arm. Tighten the lock nut and recheck the recorder travel.

(11) When this adjustment is correct recheck the recorder travel at cruising to be sure it is still within the specified tolerance.

(12) After the rate of travel of the recorder has been adjusted within the specified tolerance at cruising and at 120 mph air speed, the action of the wind velocity control may be verified by the illustrations (figure 120).

23. RADIO.

a. RADIO CONTROL CHASSIS. (*See figure* 51.)

(1) Satisfactory operation of the unit is the only test required.

(2) The unit requires no regulating and adjusting, apart from the operation of the various controls and switches, as described in Section III, paragraph 39.

(3) In the event of failure within the unit itself, reference should be made to the radio wiring diagrams (figures 52, 53, 128, and 129) and the detailed description of the circuits provided in Section III, paragraph 39.

(4) Actual repairs or adjustments must not be attempted except by an experienced radio repairman.

(5) Three adjusting screws are located on the panel of the control chassis. Their purpose, as previously outlined in Section III, paragraph 39, is as follows:

(*a*) Screw driver control (12) is used to balance the landing instrument circuits so that the vertical pointer of the landing instrument is centered when the manually operated control is centered.

(*b*) Visual marker signals are controlled by screw driver control (25), which can be set to actuate the relay keying device which closes the visual marker circuit when aural marker volume control (8) reaches a certain point on the dial.

(*c*) Screw driver control (22) is provided for balancing the radio range circuit so that a steady on course signal can be heard when the radio range beam shift control (Z) is centered on the dial.

b. RADIO RANGE KEYER. (*See figures* 57 *and* 58.)—No special test procedure is required for this unit. However, maintenance personnel should be thoroughly familiar with the following adjustment procedures:

(1) REMOVING AND REPLACING CAM ASSEMBLIES.

(*a*) A spare main cam shaft assembly is provided to simulate the British landing system. (Station identification cams are omitted in the British system.) The cam assemblies can be changed in a few seconds.

(*b*) Simply unscrew the knurled nut on the end of the cam shaft bearing pin and pull it out about two-thirds of the way.

Note

This shaft has a left-hand thread. Turn *right* to remove.

(*c*) The shaft should be pulled out only far enough to clear the main cam assembly, without releasing the switching cam. While pulling out the pin shaft, hold the main cam assembly with one hand and lift it out as the pin shaft clears it.

(*d*) In replacing the unit, ease it into place carefully so as not to damage the cam followers or contacts. No timing is necessary as this is taken care of in the main cam assembly.

(2) ADJUSTMENT OF CONTACTS.

(*a*) One of the A-N or E-T points should make contact just as the other is breaking. There should be no overlap, yet there must be no interval between opening of one contact and closing of the other.

(*b*) Both fixed contacts should just barely be touching the movable contact when the cam follower is just halfway between the high and the low parts of the cam. Another check on the adjustment is to see that when the follower is at the low part

of the cam, the fixed point which is making contact is pushed away from the adjusting screwhead the same distance as the *other* movable contact is from *its* screwhead when the follower is on the high part of the cam.

(*c*) The final test is to listen to the signal with the beam shift control (18, figure 51) in the "ON COURSE" position and the beam volume set at about 60. No excessive clicks should be heard. If the on course signal is not an even tone, back off one of the contact adjusting screws until there is a definite break in the signal; then, screw it in again until the key click just barely disappears.

(*d*) All other contacts should be adjusted so there is an air gap of 1/32 of an inch between the points when the cam follower is on the highest part of the cam.

(3) TIMING OF CAMS ON CAM SHAFT ASSEMBLY.

(*a*) If the cams are removed from the cam shaft assembly, when replacing them the spacing between the cams should be established as before.

(*b*) Each cam has a spot on one side to assist in timing. Ordinarily, the cam is placed on the shaft with this spot away from the gear. There are two keyways in each cam so it is necessary to know which one to use. Each cam must use the keyway which, when the spot on one cam lines up with the follower of that cam, permits all *other* spots to line up with *their* respective cam followers. Since the cam followers are staggered, the spots will also be staggered. (See figure 58.)

(4) ADJUSTMENT OF MOTOR POSITION AND DRIVE GEARS.

(*a*) If for any reason the motor should be removed, or its clamp screws should become loosened, it will be necessary to adjust its position to obtain proper mesh between the gear on the cam shaft and the heavy pinion which drives it.

(*b*) The motor mounting screws are in slots which permit the motor and gear train to be raised or lowered as a unit. This unit should be raised or lowered as necessary to make the cam shaft gear and its drive pinion mesh without undue slack and, at the same time, there must be no bind.

(*c*) The pivot of the small reduction gear also moves up or down with the motor assembly, in a slot in the keyer frame. Care should be exercised to avoid damage to this pivot while making adjustments.

CAUTION

This unit seldom requires adjustment if proper care is observed in changing cam assemblies and in cleaning and lubricating.

24. VIBRATOR MOTORS.

(*See figure* 104.)

a. When the vibrator motors are properly adjusted, the pointers of the instruments should move around the dials smoothly without interruption.

b. The desired adjustment may be obtained by starting with a minimum amount of vibration and gradually increasing until the behavior of the instruments is satisfactory. Vibration is minimum when the two flywheels are so attached to the shaft as to be directly opposed to each other, as shown in position (A) and maximum when they are in line, as shown in position (B). Position (C) shows how to obtain a mean amount of vibration, with setscrews spaced at 90 degrees.

CAUTION

Too much vibration as well as excessive end play of the flywheels may cause erratic instrument indications. The inner flywheel should be set on the shaft so that the end play in the shaft is .002 or .003 of an inch. However, upon spinning by hand, the motor must be free running.

c. To test instrument indications in relation to the setting of the vibrator motors, turn on the ignition switch, set the throttle to attain various airspeed indications and note the steadiness of airspeed indicator at various speeds. Too much vibration will cause unsteady indications. Similarly, note the indications in respect to the manifold pressure indicator. Observe the indications of the vertical-speed indicator and the altimeter at various altitudes. Adjustment of the vibrator motor located on the back of the main instrument panel alone will control the smoothness of operation of the manifold pressure indicator, but the vibrator motors on either the remote instrument transmitter panel or the remote instrument panel on the operator's desk may be responsible for unsteady indications of the airspeed, altimeter, or vertical-speed indicators.

25. VACUUM TURBINE.

a. To test and adjust the actual output of the turbine, a special fitting should be made using an ordinary piece of 2-inch water pipe, 7 or 8 inches long, standard pipe thread on each end. (See figure 121.) On one end of the pipe install a standard pipe cap with a 5/16-inch hole drilled through it. An additional 3/16-inch hole is drilled in the pipe 3 inches from the pipe cap. To this hole a piece of 3/16-inch copper tubing 1 inch long is soldered.

b. Remove the nipple bushing from the end of the turbine and screw in the fitting. Connect a mercury gage to the copper tube in the side of the fitting by means of a flexible tube. Use an actual mercury column type gage, if possible, as spring type gages are frequently out of calibration from rough handling.

WARNING

The line voltage must be between 110 and 115 volts when making this check. Do not attempt to increase the speed of the motor if the voltage is temporarily low as this will result in too high rpm when the voltage returns to normal.

c. Start the turbine and allow it to warm up for at least 30 minutes. Then, check the mercury gage reading and, if it is less than 4-3/8 inches Hg, the speed of the motor should be increased.

d. To increase the speed of the motor, loosen the four hex bolts and turn the end bell clockwise just a little by tapping it with a wooden block and hammer. Tighten the four bolts and test the output with the vacuum gage. (See figure 122.) Repeat this operation until the proper reading is obtained on the vacuum gage.

CAUTION

The speed of the motor should not exceed 8000 rpm. However, this is not critical. If

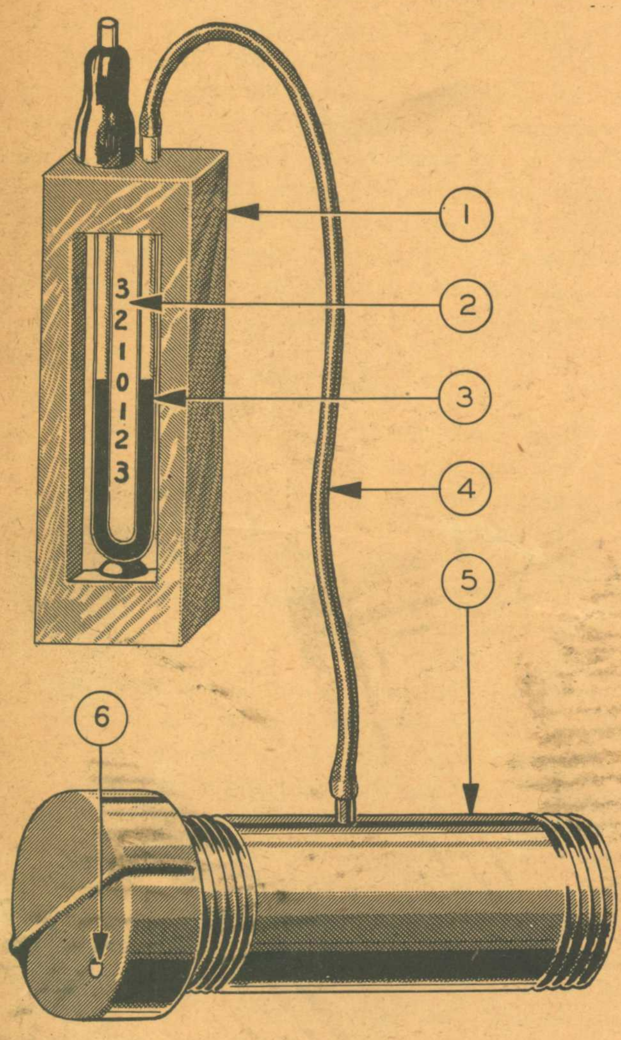


Figure 121—Vacuum Test for Turbine

1. *Wood Frame*
2. *Cardboard with Numbers*
3. *Mercury Tube (Glass)*
4. *Rubber or Flexible Hose*
5. *Connect to Turbine Intake*
6. *5/16-inch Hole*

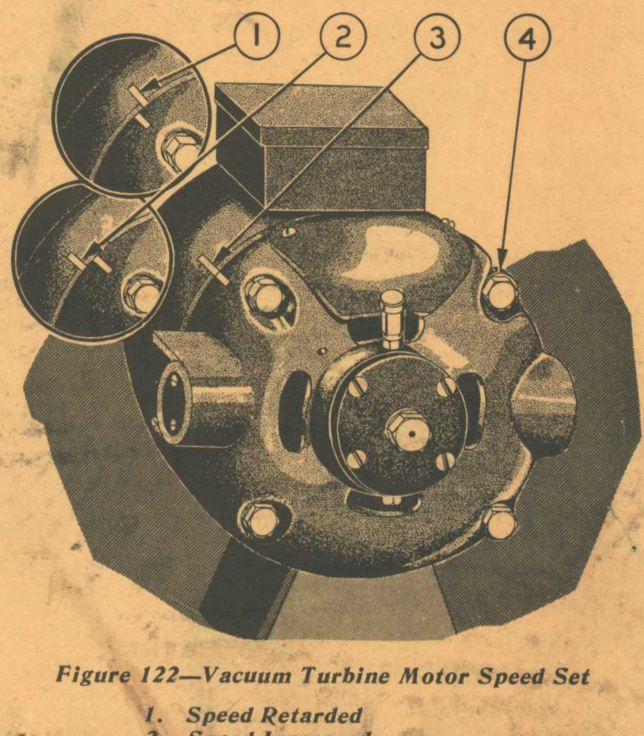


Figure 122—Vacuum Turbine Motor Speed Set

1. *Speed Retarded*
2. *Speed Increased*
3. *Normal Speed Setting*
4. *Hex Bolts Holding End Bell*

there is no revolution counter available, it is safe to adjust the end bell so that the turbine produces as high as 4-1/2 inches Hg.

e. In some instances it is possible to advance the end bell too far so that the turbine output starts to drop off instead of increase with further adjustment.

Note

The above values are based upon atmosphere at approximately sea level density.

26. TELEGON OSCILLATOR.

(*See figure* 111 *and wiring diagram, figure* 123.)

a. If a suitable meter is not available, the 700- to 800-cycle frequency may be tested by touching one tip of a pair of headphones to one side of the output and comparing the tone with any source of a 700 to 800 CPS note such as a tuning fork or some musical instrument.

b. On rare occasions it has been necessary to vary the value of condenser (C-6) from as little as .5 to as much as 1.5 mfd to obtain the correct output. This change should not be made, however, until everything else has been proven to be perfect.

c. A description of this unit is contained in Section II, paragraph 2*a*(6). The wiring diagram (figure 123) contains test data for guidance in testing and adjusting.

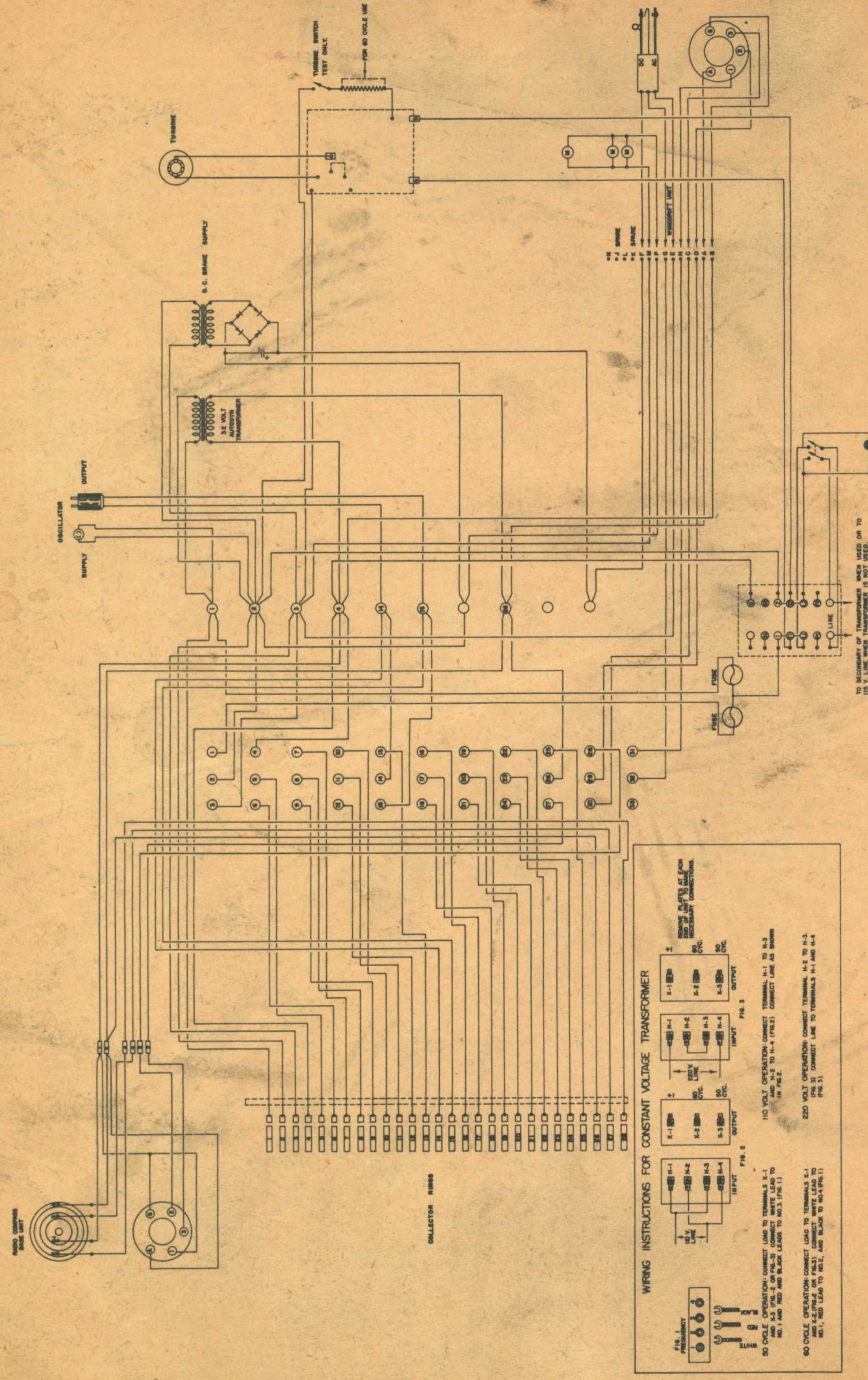


Figure 123—Base Wiring Diagram

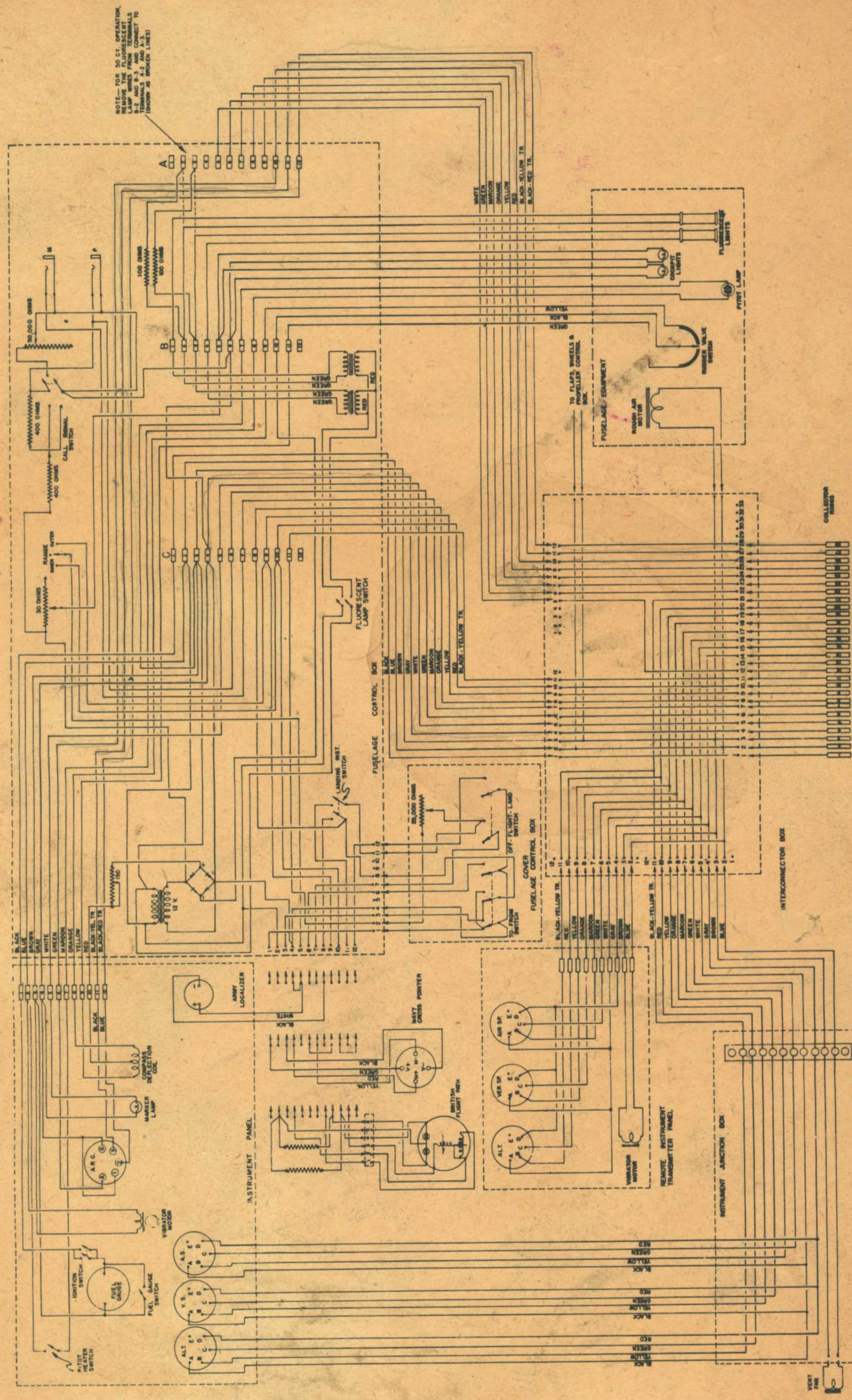


Figure 124—Fuselage Wiring Diagram (Applicable to Instrument Flying Trainers, AN-2550-1, beginning with Link Serial No. 5551)

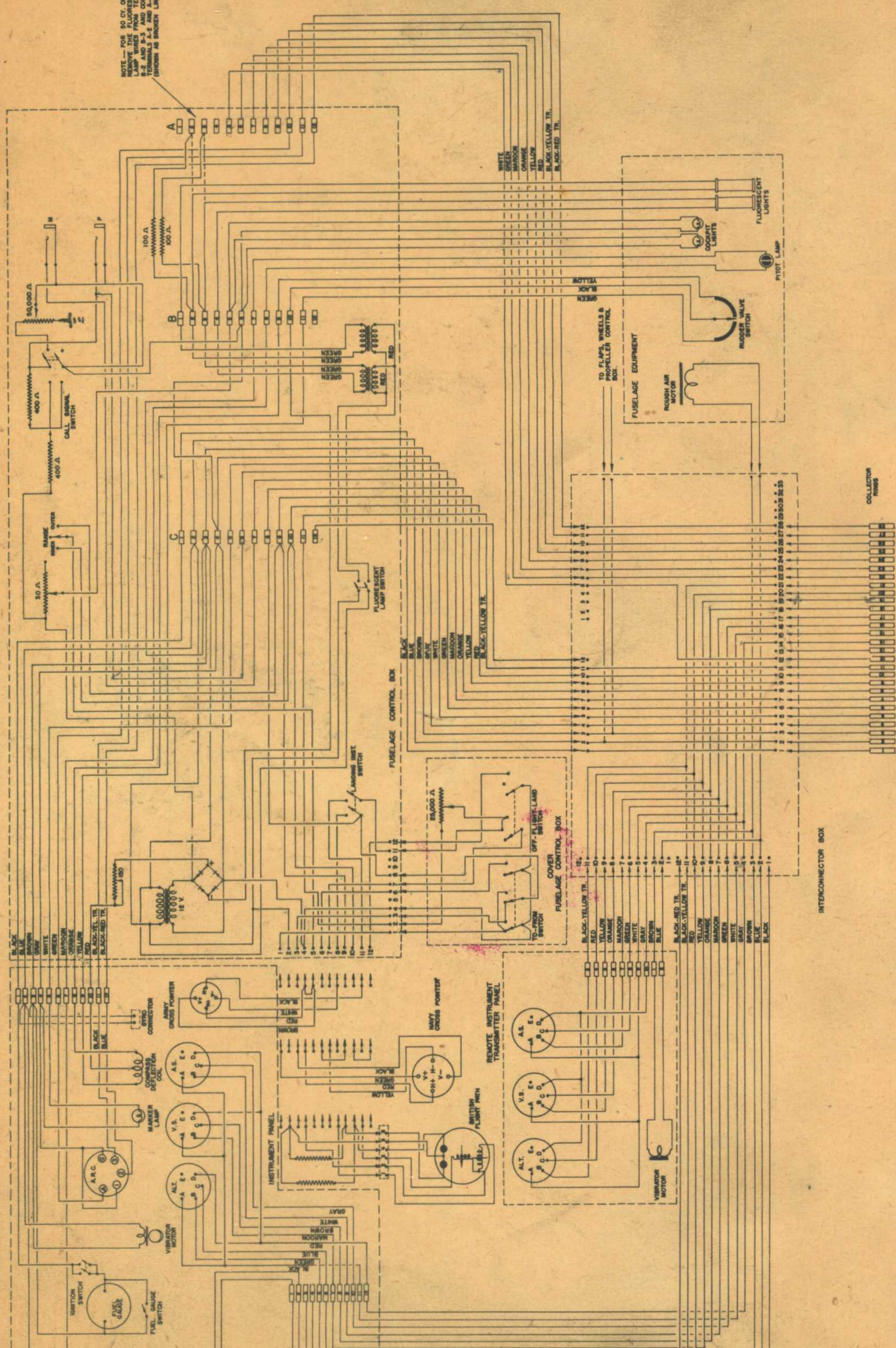


Figure 125—Fuselage Wiring Diagram (Applicable only to Instrument Flying Trainers, AN-2550-1, Link Serial Nos. 4395 to 5550, inclusive)

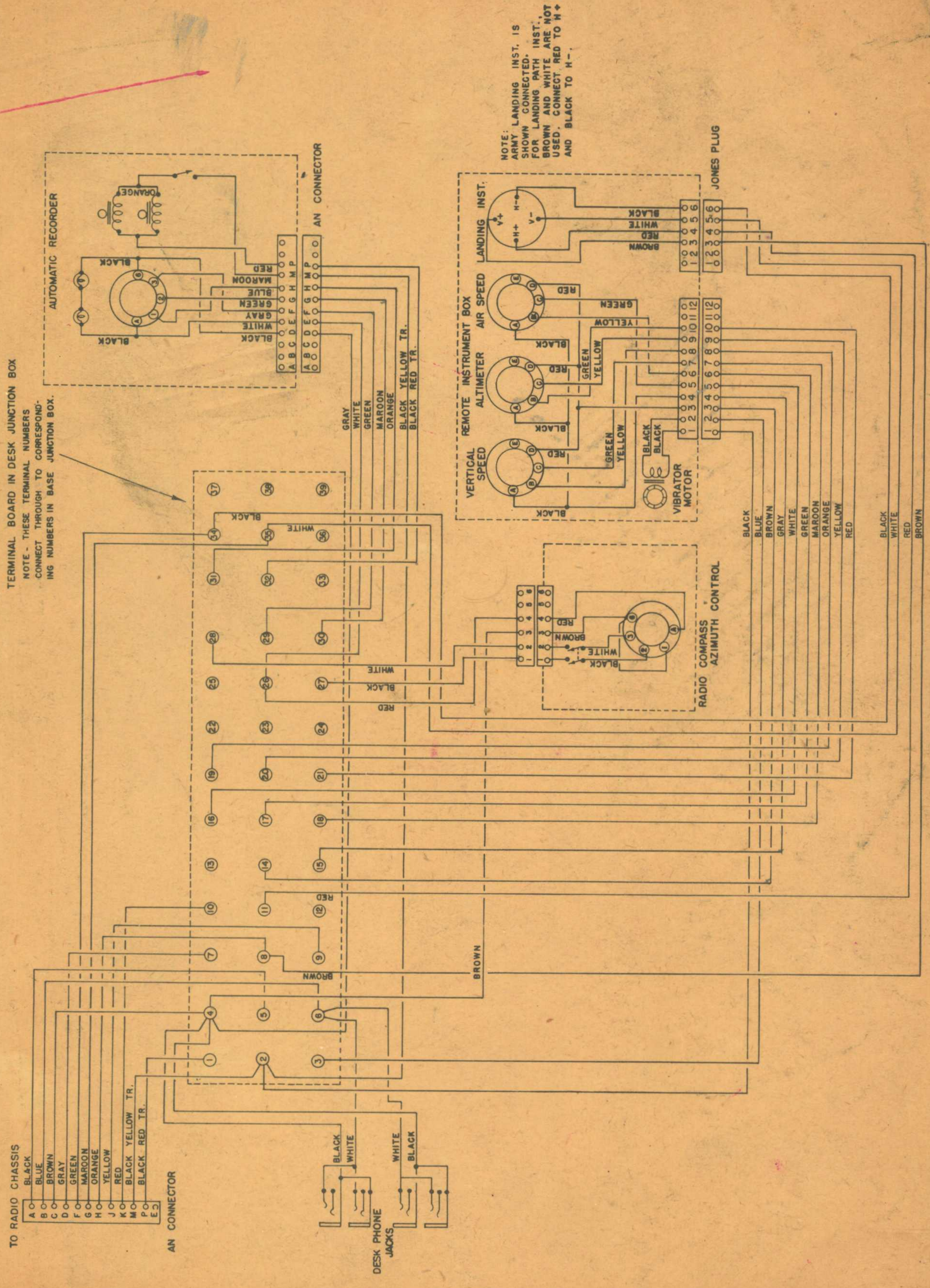


Figure 126—Desk Wiring Diagram (Applicable to Instrument Flying Trainers, AN-2550-1, beginning with Link Serial No. 5551)

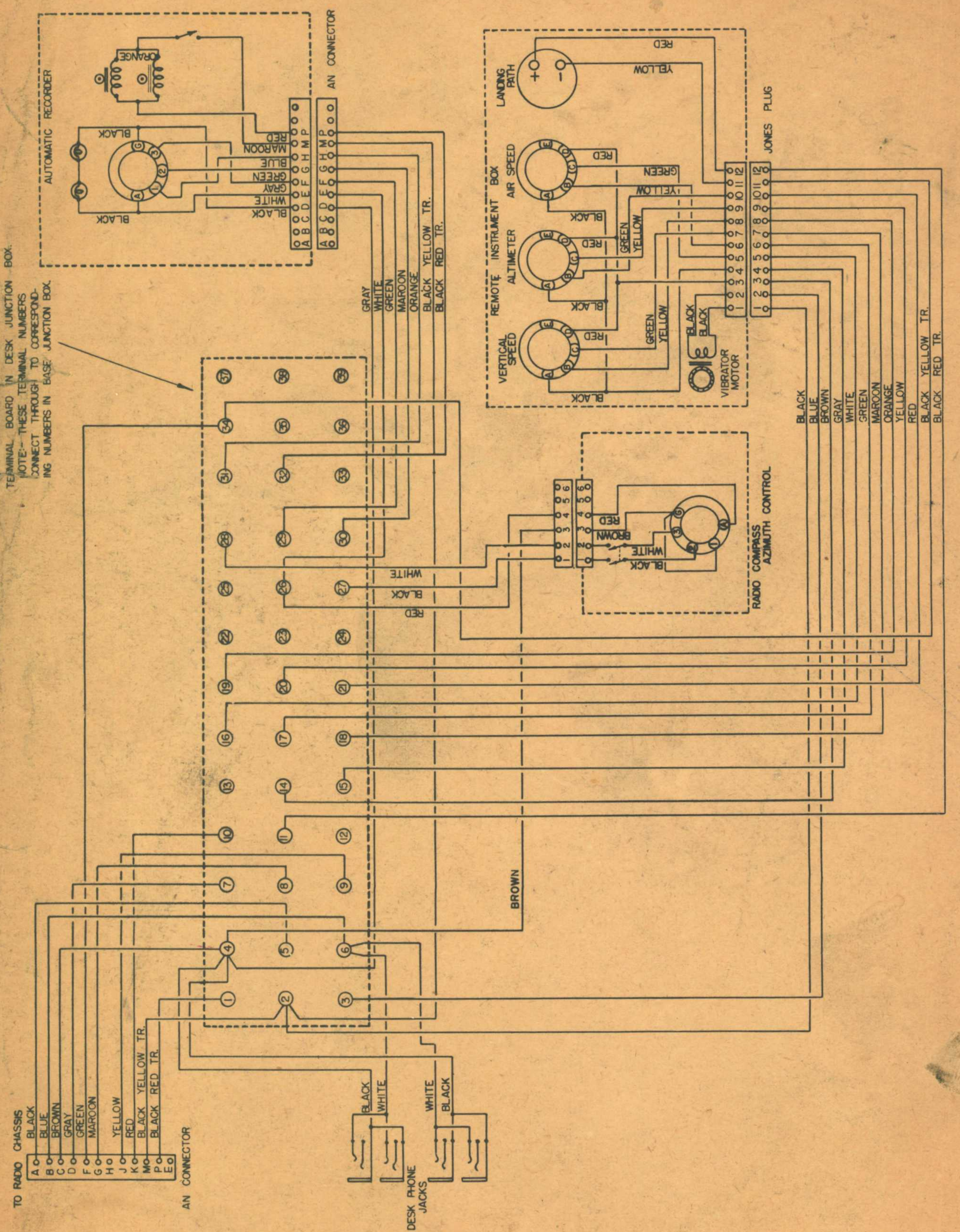


Figure 127—Desk Wiring Diagram (Applicable only to Instrument Flying Trainers, AN-2550-1, Link Serial Nos. 4395 to 5550, inclusive)

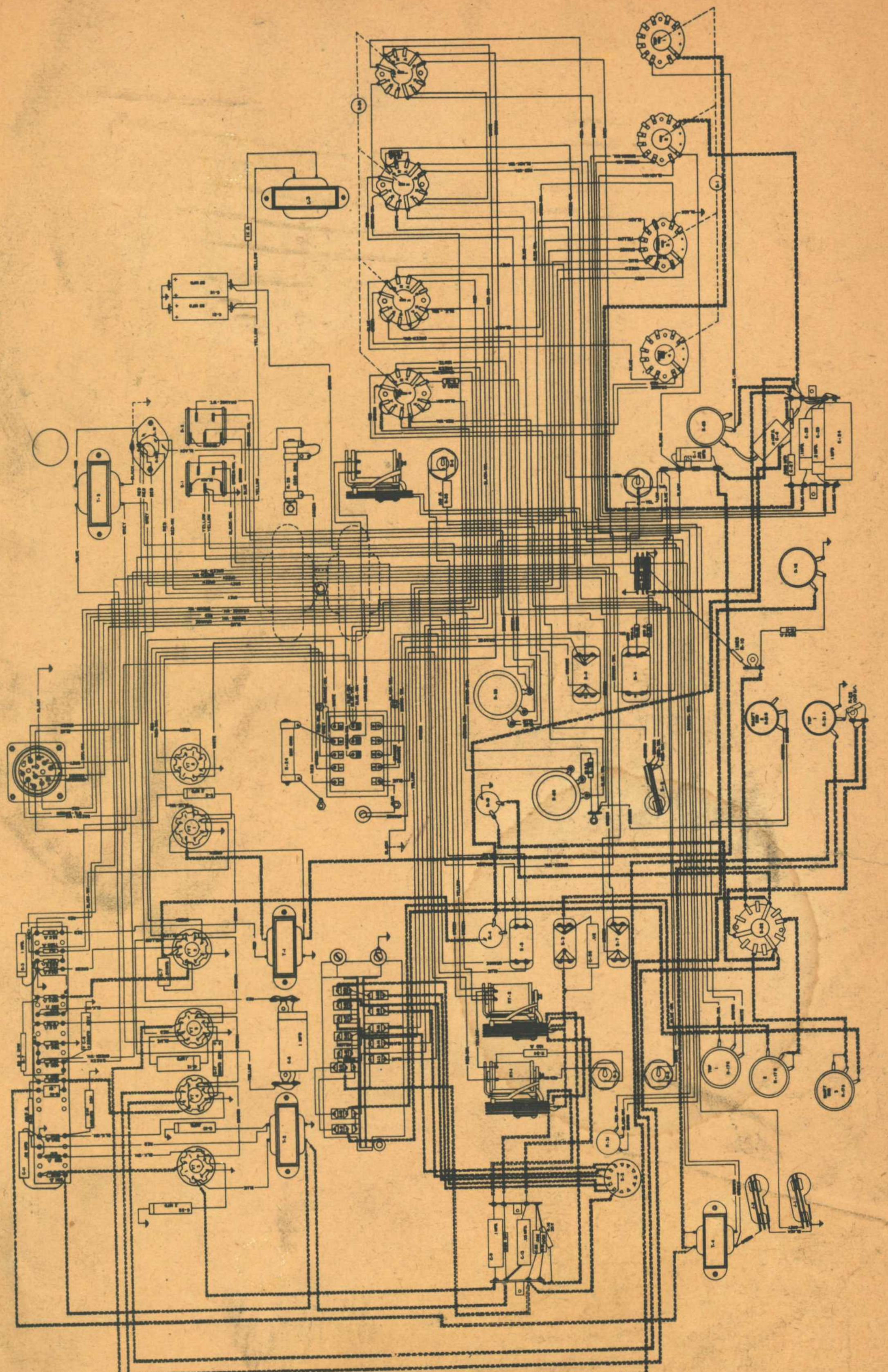


Figure 128—Radio Pictorial Wiring Diagram (Applicable to Instrument Flying Trainers, AN-2550-1, beginning with Link Serial No. 5551)

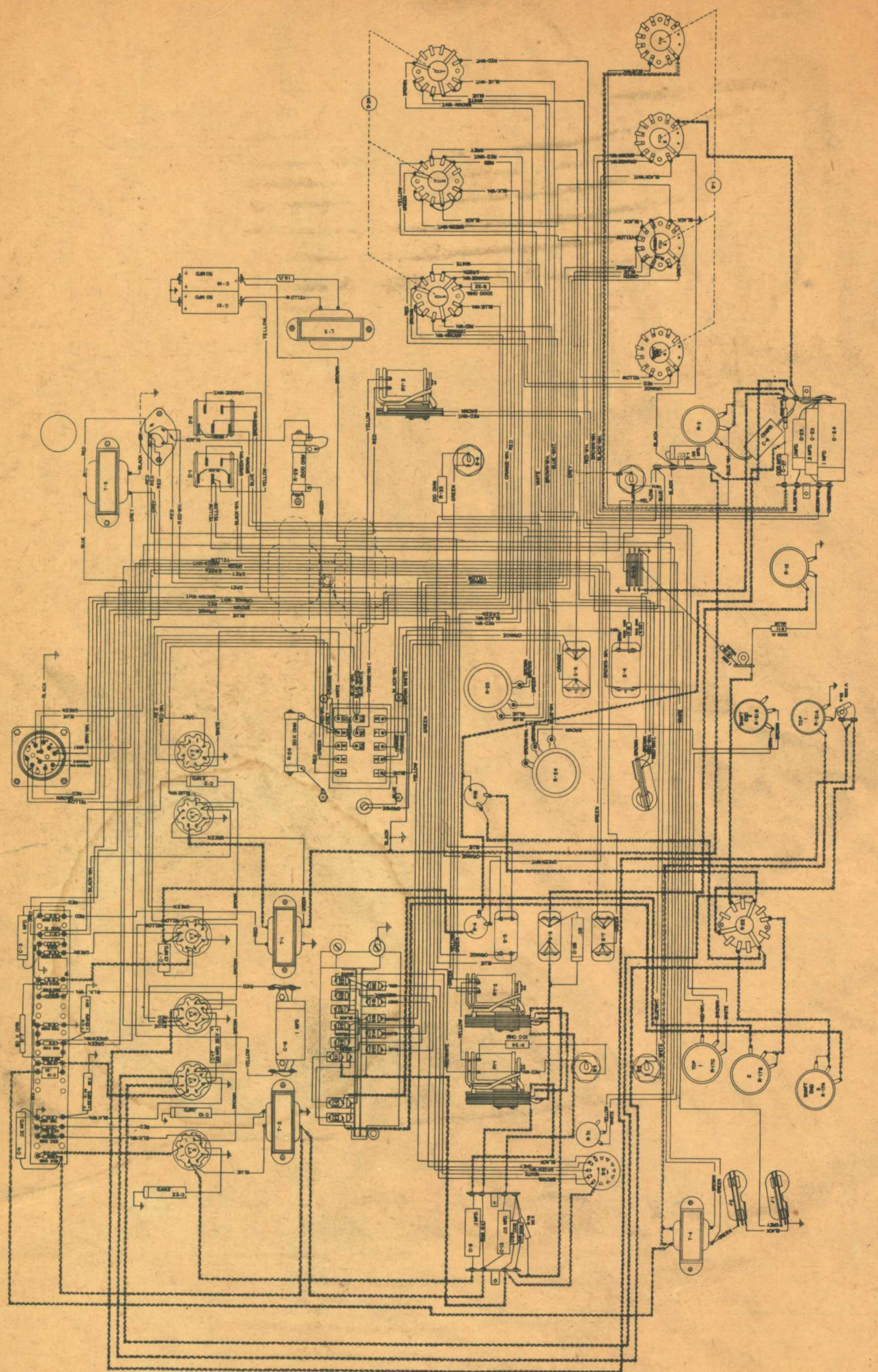
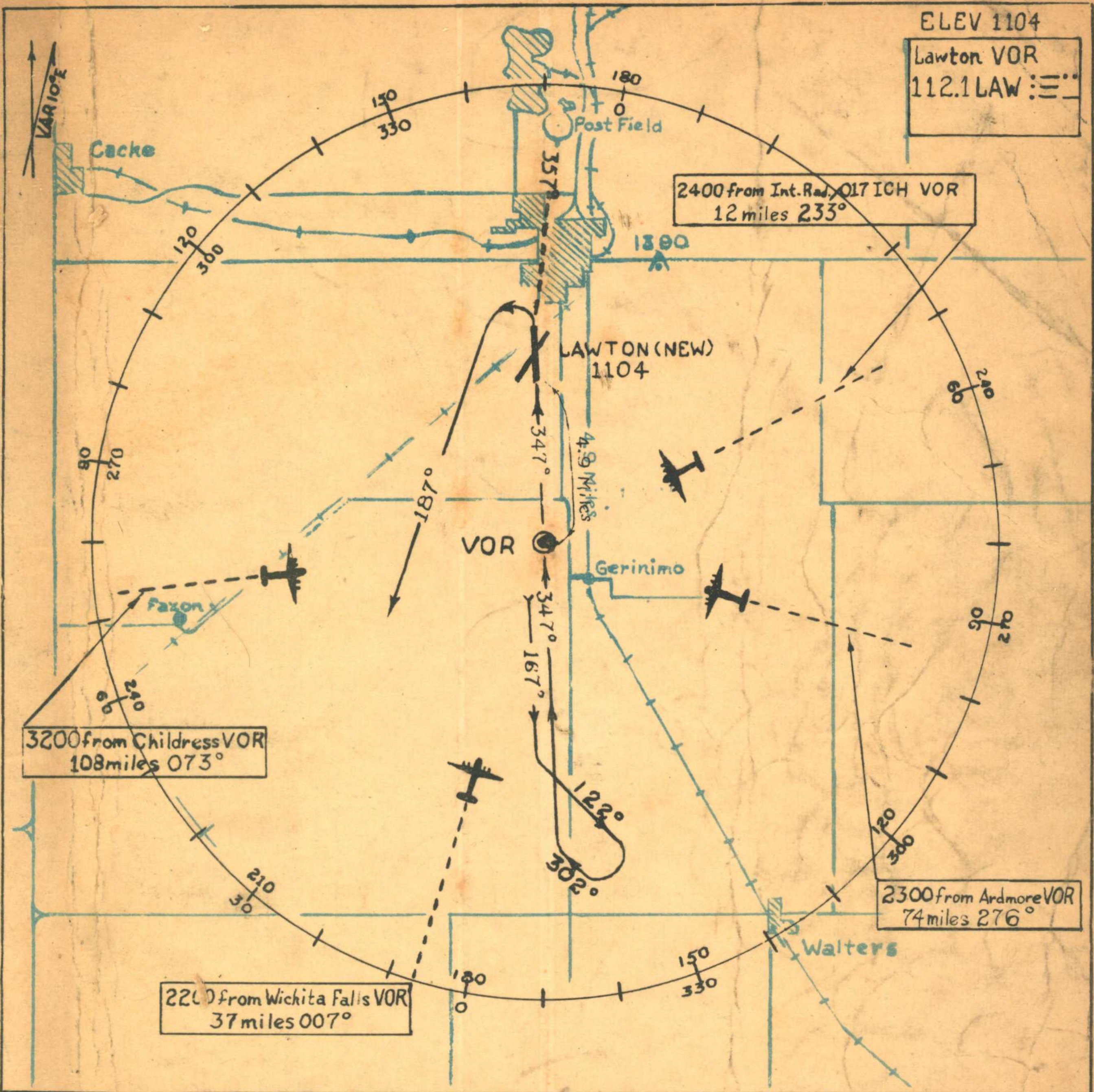
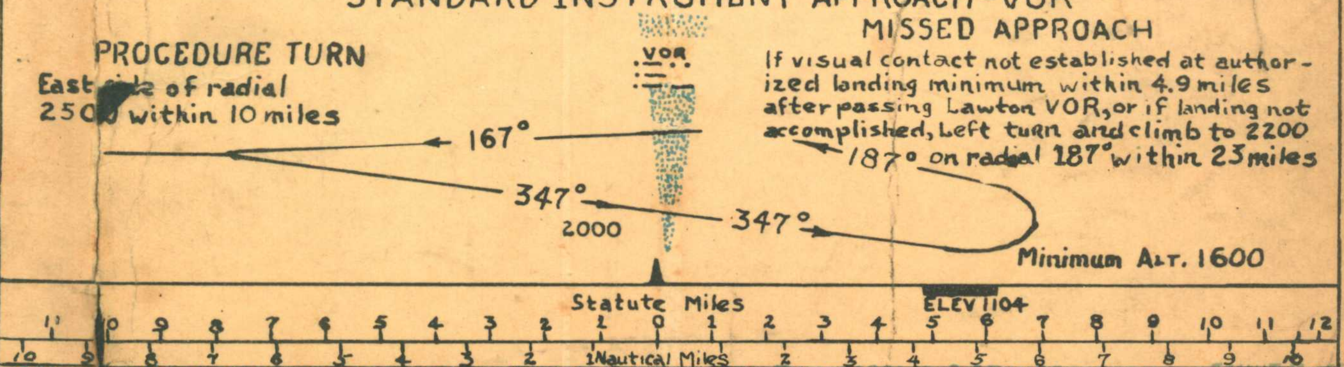


Figure 129—Radio Pictorial Wiring Diagram (Applicable only to Instrument Flying Trainers, AN-2550-1, Link Serial Nos. 4395 to 5550, inclusive)

LAWTON-VOR



STANDARD INSTRUMENT APPROACH-VOR



CEILING AND VISIBILITY MIN.			TIME IN MINUTES AND SECONDS TO AERODROME-DISTANCE 4.9 STAT. 4.25 NAUT. MILES									
TAKEOFF	DAY	NIGHT	M.P.H.	100	120	140	160	KNOTS	90	100	110	120
LANDING	DAY	NIGHT		2:56	2:27	2:06	1:50		2:50	2:33	2:19	2:07